Vol. 7, No. 4 APRIL, 1953

AGRICULTURAL CHEMICALS

NAC Associates Meets in Calif. • Present Legislation Adequate • Rodenticide Story • New Arsenical Fungicide Research Fundamentals • Fertilizer Trends • Pesticides at ACS Meeting • Air Blast Short Course • Fertilizer Supply Outlook • Pesticide Residue Problems • USDA Pesticide Survey • New Texas Plant

PROFITABLE PASTURES

People who know estimate that as a result of the Green Pastures program hundreds of thousands of acres of low-productive land are now in the profit-producing class.

There is still vast acreage to be redeemed by the intelligent use of grassland farming methods.

P. C. A. will make every effort this year to encourage the Green Pastures program.

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Why do more and more processors use Attaclay across the board?

Because it yields savings from purchase order to finished product

A growing number of formulators have adopted Attaclay as their *across-the-board* carrier and diluent. That's quite a vote of confidence, for their individual product lines might well range from six to sixty formulations covering dust bases, wettable powders, and finished dusts. One customer sums up the case this way: "Attaclay does so many different jobs so well that savings show up all along the line!"

Here's what he's talking about. Using only Attaclay, his stock situation is streamlined, and capital tied up in carrier inventory is minimized. Scheduling and procurement are simplified.

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Credit Attaclay with four more big "assists": (1) a record of trade preference for use with all the technical chemicals—from DDT through dilan; (2) top-flight performance in all types of solids-grinding or liquid impregnation equipment; (3) a brand new meaning to processing ease; (4) a fine new standard of product quality.

Isn't Attaclay worthy of *your* complete trust? We'll help you prove the point.

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JUST OFF PRESS—the second booklet in a newly-inaugurated series called Attaclay Pesticide Digest. These bulletins will discuss various aspects of pesticide processing. A brief note will bring your copy, and future Digests as published.

Let's face the facts about

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Phosphates

(POWCO BRAND Parathion / TEPP)

PARATHION and **TEPP** are highly toxic organic phosphates... yet when handled with proper caution, they are useful and effective insecticides.

The greatest risk of toxicity is in manufacturing and blending from the technical material. We relieve you of this hazard... furnish you with POWCO BRAND TEPP as 40% liquid concentrate...POWCO BRAND PARATHION as a 2-lb. emulsion, 25% dust or 15% wettable powder

Although most of the risk is taken in our plants, these products still require constant precaution. If in doubt, call our Technical Service Department.

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TOXAPHENE
BHC
CHLORDANE
LINDANE
ROTENONE
SABADILLA
PYRETHRUM & PYRIN
PIPERONYL BUTOXIDE
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2, 4-D & 2, 4, 5-T

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AGRICULTURAL CHEMICALS

THIS MONTH'S COVER

Bay Bridge, San Francisco, one of the spots sure to be visited by members of the National Agricultural Chemicals Association at the group's first west coast meeting in 15 years. West coast members of the trade were rolling out the welcome mat for the NAC, as illustrated in the guest editorial in this issue (page 39) by W. E. Ball, president of the Western Agricultural Chemicals Association.

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A Monthly Magazine For the Trade

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LAWRENCE A. LONG
Editor

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US AGRICULTURAL CHEMICALS

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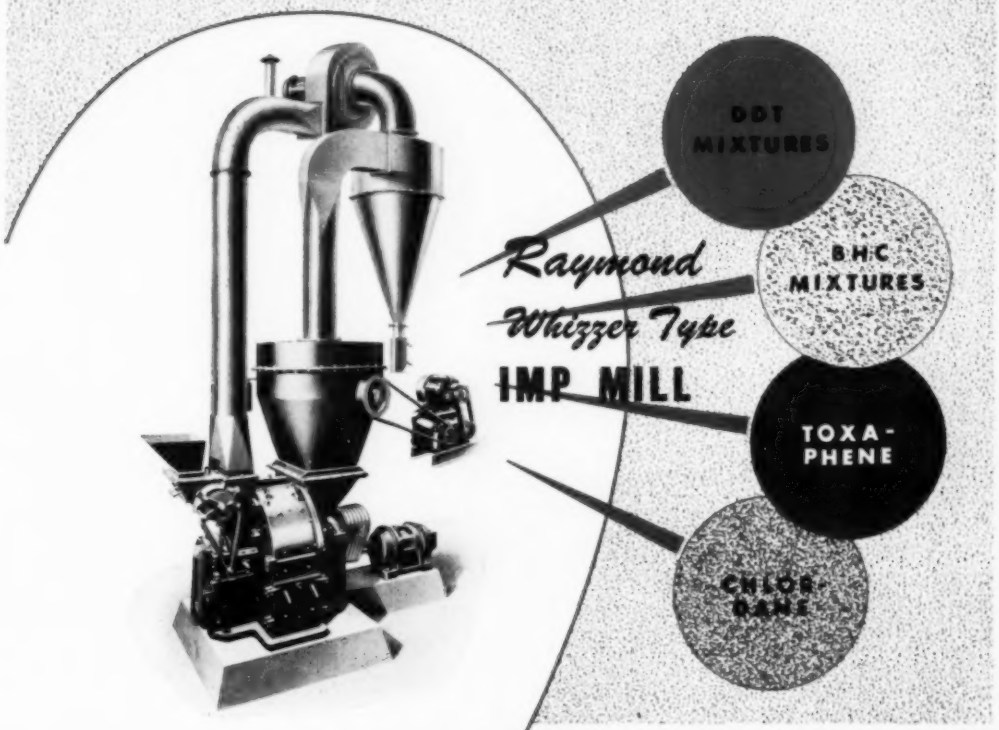
A LOW-COST PRODUCER

of Blended Field Strength Insecticides



Ask for Bulletin No. 68—covering the Raymond line of insecticide pulverizing equipment.

The operating records of the many Raymond installations now in use show Imp Mills to be highly efficient units for grinding and intimately blending field strength insecticides. At the same time, finer and more consistent finished products are produced with this unit.

The Raymond Imp Mill has no screens to break, wear out, or clog. The air separation system used for classifying and conveying provides a cooling medium for removing heat generated in pulverizing. Lower mill temperatures permit greatly extended operating periods without shutdowns.

Whatever your capacity requirements or dust formulating problem may be, there is a Raymond Mill for handling your job economically to meet today's maximum specifications.

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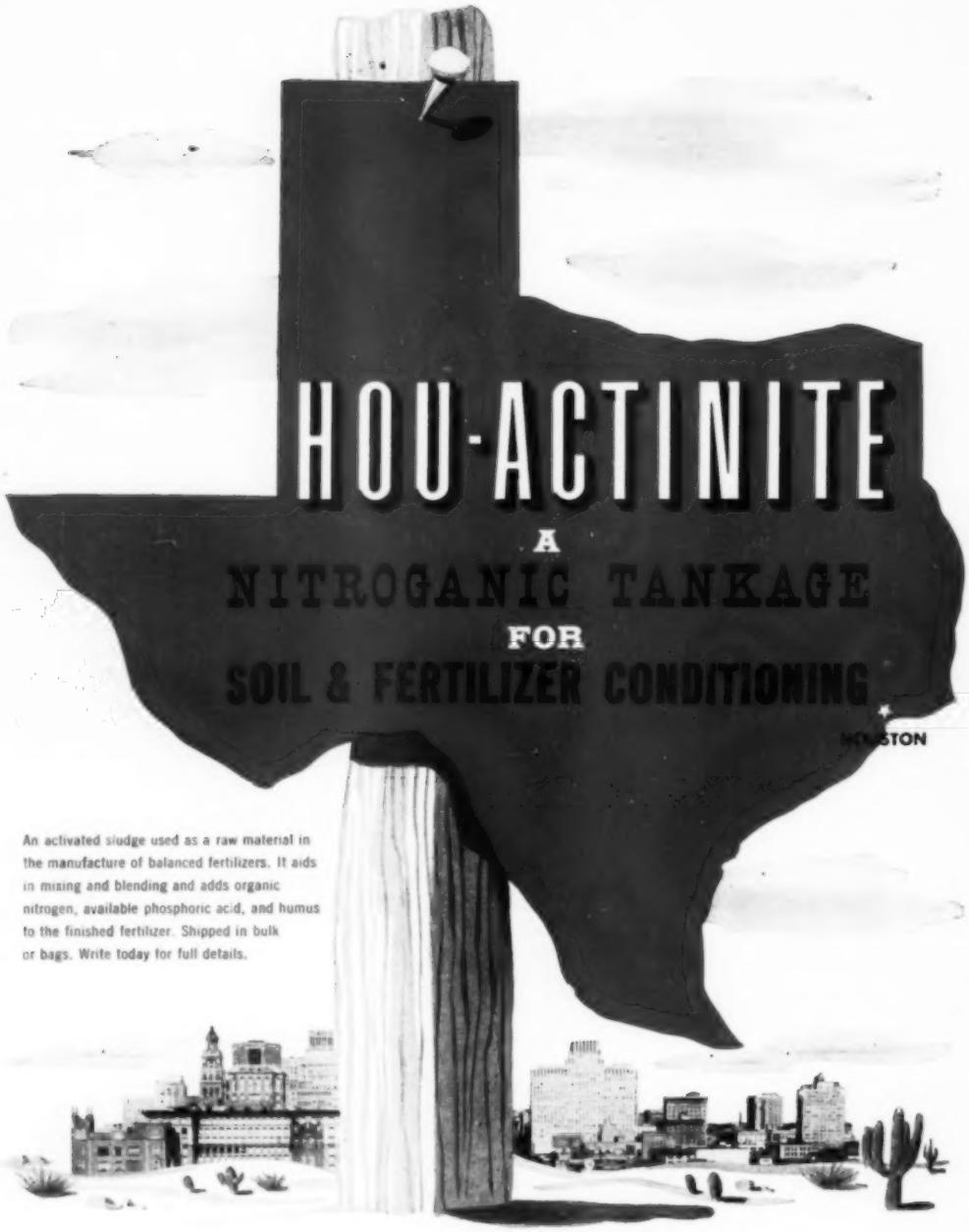

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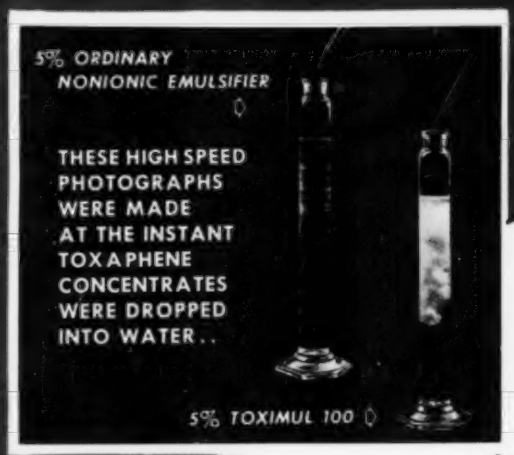
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use

NINOL TOXIMUL

a balanced anionic emulsifier for agricultural insecticides

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Please send me sample and further information about TOXIMUL emulsifiers. Our major product type is:

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**DARVAN is a dispersing agent, not a wetting agent. DARVAN does not appreciably affect surface tension.*

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Specialties Department

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POSITION _____

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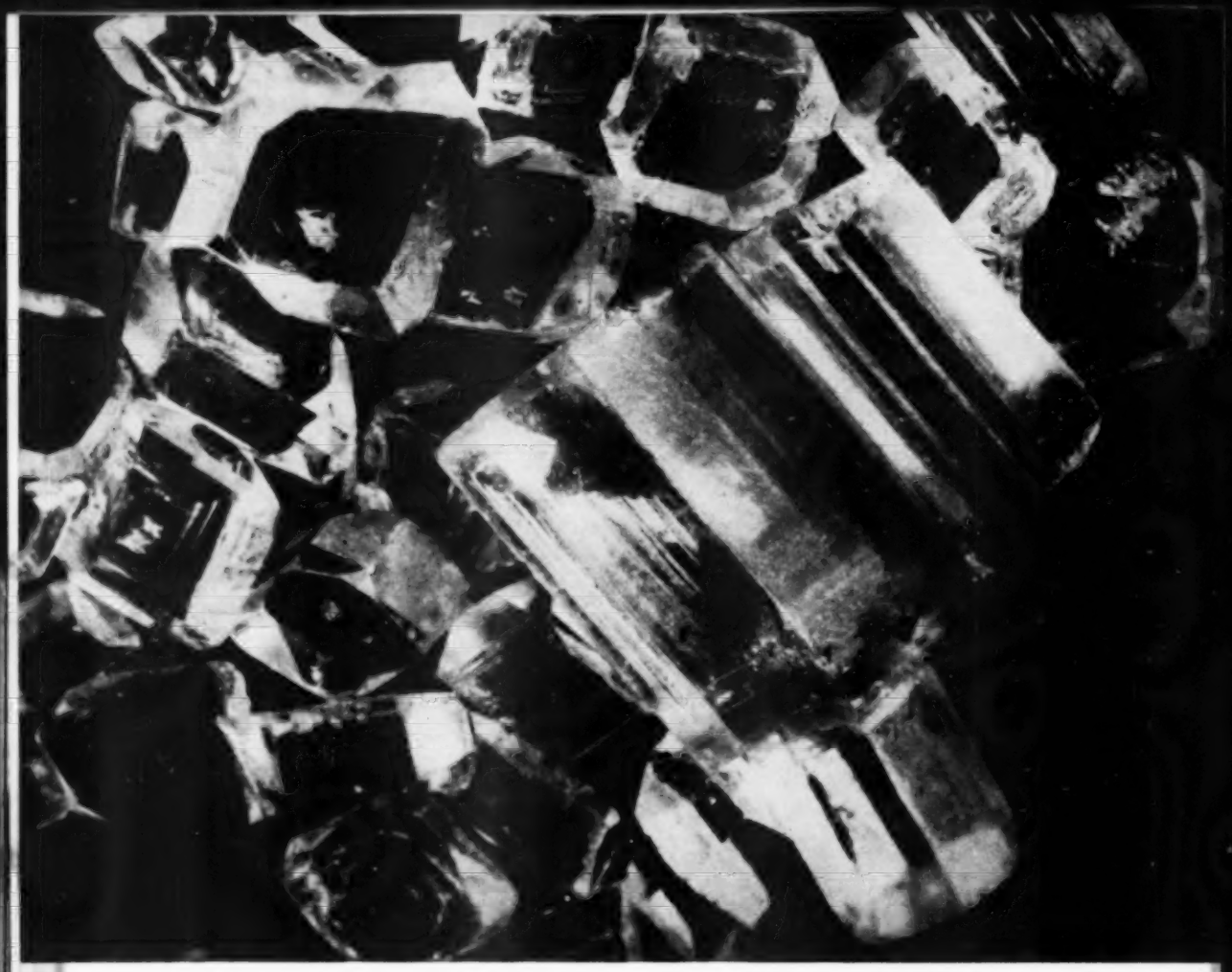

Announcing LINDANE

LINDANE is a new product of DIAMOND ALKALI's subsidiary, KOLKER CHEMICAL WORKS, INC., specializing in organic chemicals for agriculture and industry. *Write today for prices and specifications on* LINDANE *to:*

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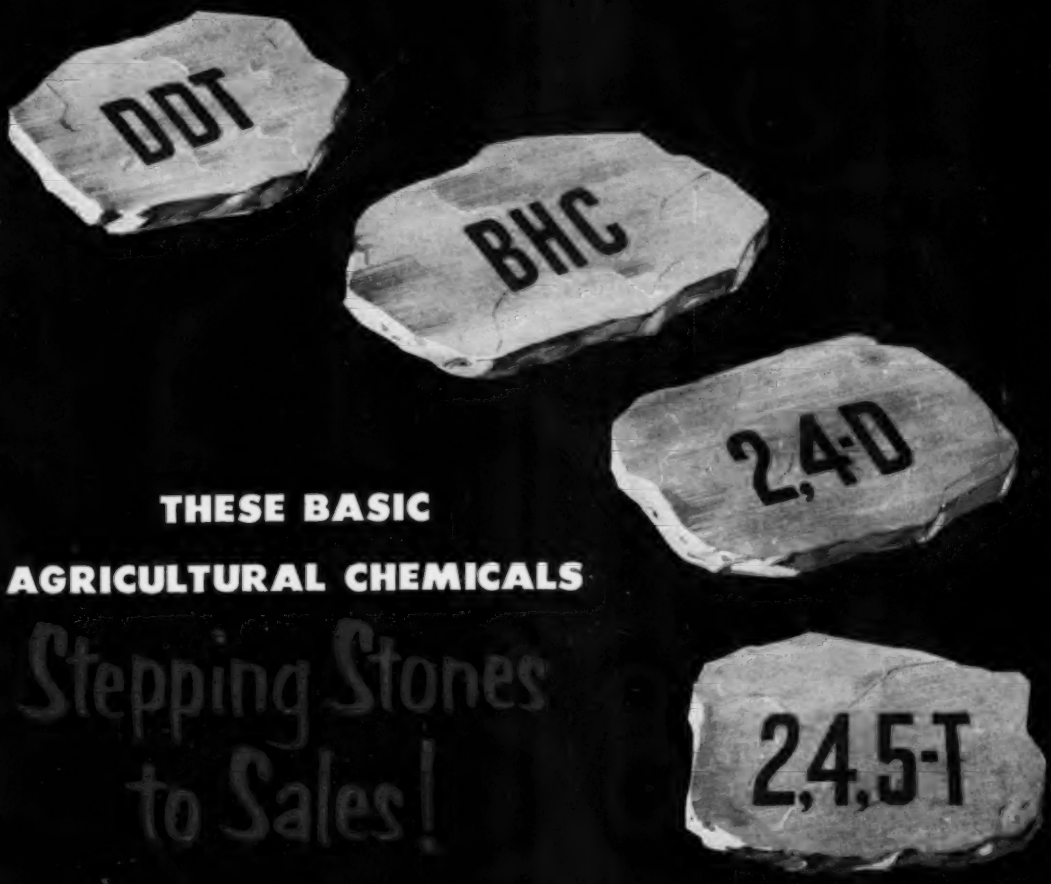
LINDANE, the effective multi-purpose insecticide containing 99% gamma isomer of benzene hexachloride is now available in commercial quantities. LINDANE, together with KOLKER high gamma BHC technical, now offer manufacturers basic BHC materials easily handled and readily formulated into high-quality finished insecticides.

DIAMOND ALKALI COMPANY

Chemicals you live by



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BHC	Lindane (99% gamma isomer) Technical grade (36% gamma) 12% gamma concentrates
2,4-D	Butyl Ester Isopropyl Ester Ester and Amine Salt Solutions Low-volatile Esters
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DIAMOND ALKALI CHEMICALS

Now

Federal registration

***of* aldrin**

for soil insect control

ONE OF the most important announcements to be made in the history of agricultural pest control is the official recognition recently granted ALDRIN as a control chemical for many soil insects. Registration was based on knowledge gained from some of the most thorough and far-reaching tests ever to be made of the effectiveness of a soil insecticide, and conclusive proof that ALDRIN when used in the soil is not translocated.

This use of ALDRIN in the soil opens a vast new market for insecticides. It provides a new dimension for insect control and by eliminating a substantial impediment to crop development, promotes early maturity and radical improvement in yield and quality.

aldrin LABEL DATA

Formulations—Emulsifiable Concentrates, Wettable Powders and Dusts (2½% or 5%) can now be registered for control of the following important soil insects on crops indicated:

1 **Wireworms on sugarcane, corn, sugar beets, and small grains.**

2 **White grubs on sugarcane, corn and small grains.**

3 **Sugar beet maggots and white grubs on sugar beets.**

4 **Rootworms on peanuts.**

5 **Rootworms on corn in Iowa and adjacent states.**

6 **Japanese beetle grubs, white grubs, green June beetle larvae, lawn chinch bugs, and ants in turf, in ornamental, nursery and greenhouse soil where ornamentals are grown.**

Write for new folder

Write now for folder containing comprehensive data on uses, dosages and methods of application of ALDRIN for soil pest control.

Note difference in size of ears, resistance to lodging, and extent of root systems on corn plants grown in adjacent rows of ALDRIN-treated and untreated (control) soil.

Julius **HYMAN** *& Company*

DENVER, COLORADO

Shell Chemical Corporation, New York City, exclusive distributors of unformulated Aldrin and Dieldrin in the United States.

Her fingertips imagine the taste

The lady doesn't trust her eyes alone.

The buyer of Multiwalls is in much the same position.

Aside from package design, it's hard to tell one manufacturer's bag from another's simply by looking at it or fingering it.

Put the bags out of sight and you may be able to see many differences.

Men who buy 85 per cent of all Multiwalls consider* these intangibles more important than any other factor when they choose their supplier.

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"Is this company big enough?"

"Do they have a fair allocation policy?"

"Are their prices competitive?"

"Do they respect delivery dates?"

In a nutshell—

"Are they good people to do business with?"

We can't tell you what the answers are when these Multiwall users consider Union. This we do know . . . and the inference is yours to make—

In these days of industrial pressure, when *dependability* is a fervent wish as well as a word, men to whom Multiwalls are important are placing an increasing share of their orders with Union.

More so every day . . .

IT'S UNION FOR MULTIWALLS

*August, 1951 research study.

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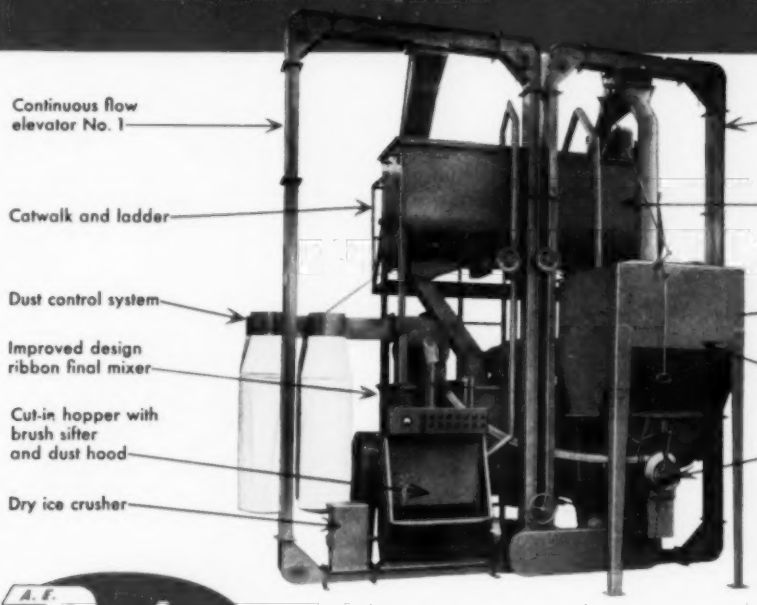
FOR FORMULATING CONCENTRATES . . . and

Processing and Packaging Field Strength Insecticides


Continuous flow elevator No. 1
Catwalk and ladder
Dust control system
Improved design ribbon final mixer
Cut-in hopper with brush sifter and dust hood
Dry ice crusher
Continuous flow elevator No. 2
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Fine grinding pulverizer (not visible in picture)
Holding bin
Automatic valve bag packer

UNI-BLENDOR
Dual Type
COMPLETE in one compact unit
. . . NOTHING TO ADD

A. E. Poulsen & COMPANY R.T.R.* **UNI-BLENDOR**

PATENT APPLIED FOR

The R. T. R. UNI-BLENDOR—*Dual type*— performs a dual function:

1. *Formulates concentrates from technical grade toxicants*

2. *Processes concentrates to produce field strength insecticides*

Handling 40 cu. ft. batches, the equipment requires only 11′ x 11′ of floor space and 16′ of head room. Each unit is plant tested to insure maximum efficiency and is shipped in sections which any mechanic can readily assemble.

* * * * * * * *

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"We fertilized part of our pasture last spring with 10-10-10 at about 500 pounds per acre. The growth of grass was so rank we could have cut a hay crop by the middle of June.

"In a demonstration set up on our pasture by the county agricultural agent, yields were taken. The unfertilized area made 2531 pounds of dry material per acre, and the fertilized made 5737 pounds per acre, an increase of 2905 pounds. This extra feed was the equivalent of 16-18% dairy feed which, at $60 a ton, would be worth about $90."

GALE CHASE

Bigger yields for farmers mean better business for you

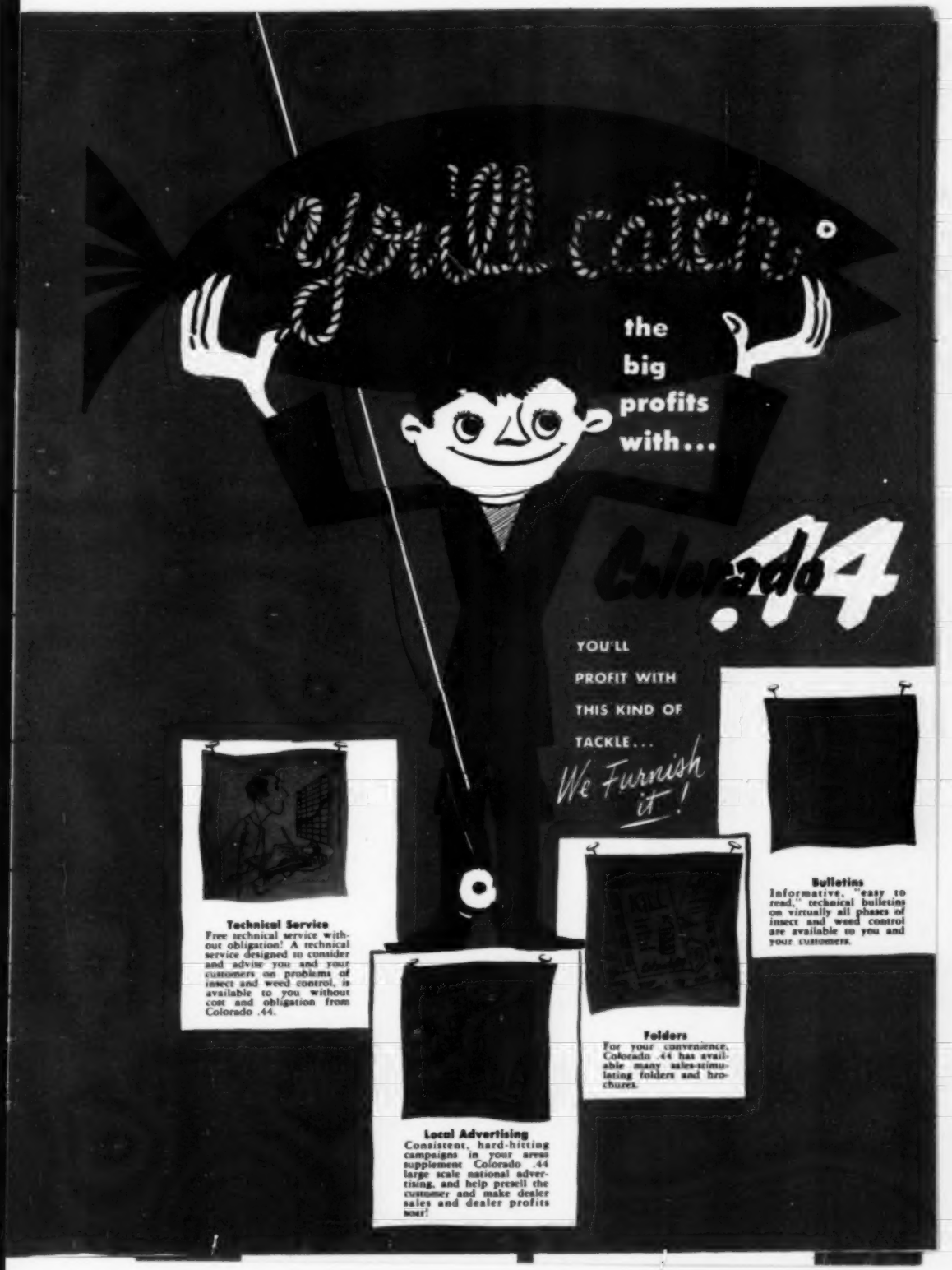
● High-nitrogen mixed fertilizers have proved again and again that they pay their own way and give the user a nice profit to spare. As farmers learn more about their benefits, demand goes up and up.

To give your customers the most effective high-nitrogen fertilizers, use U·S·S Ammonium Sulphate for a major part of the nitrogen content. It's a dry, free-running material that stands up well in storage and performs well in distributing equipment. Its all-ammonia nitrogen won't leach, yet becomes readily available during the growing season.

Promotion efforts you put behind high-nitrogen fertilizers containing U·S·S Ammonium Sulphate will yield big returns. You and your dealers can recommend it for pastures, corn, wheat and other small grain. The spring fertilizer season is at its height; get your share of this business. United States Steel Company, 525 William Penn Place, Pittsburgh 30, Pa.

U·S·S AMMONIUM SULPHATE

UNITED STATES STEEL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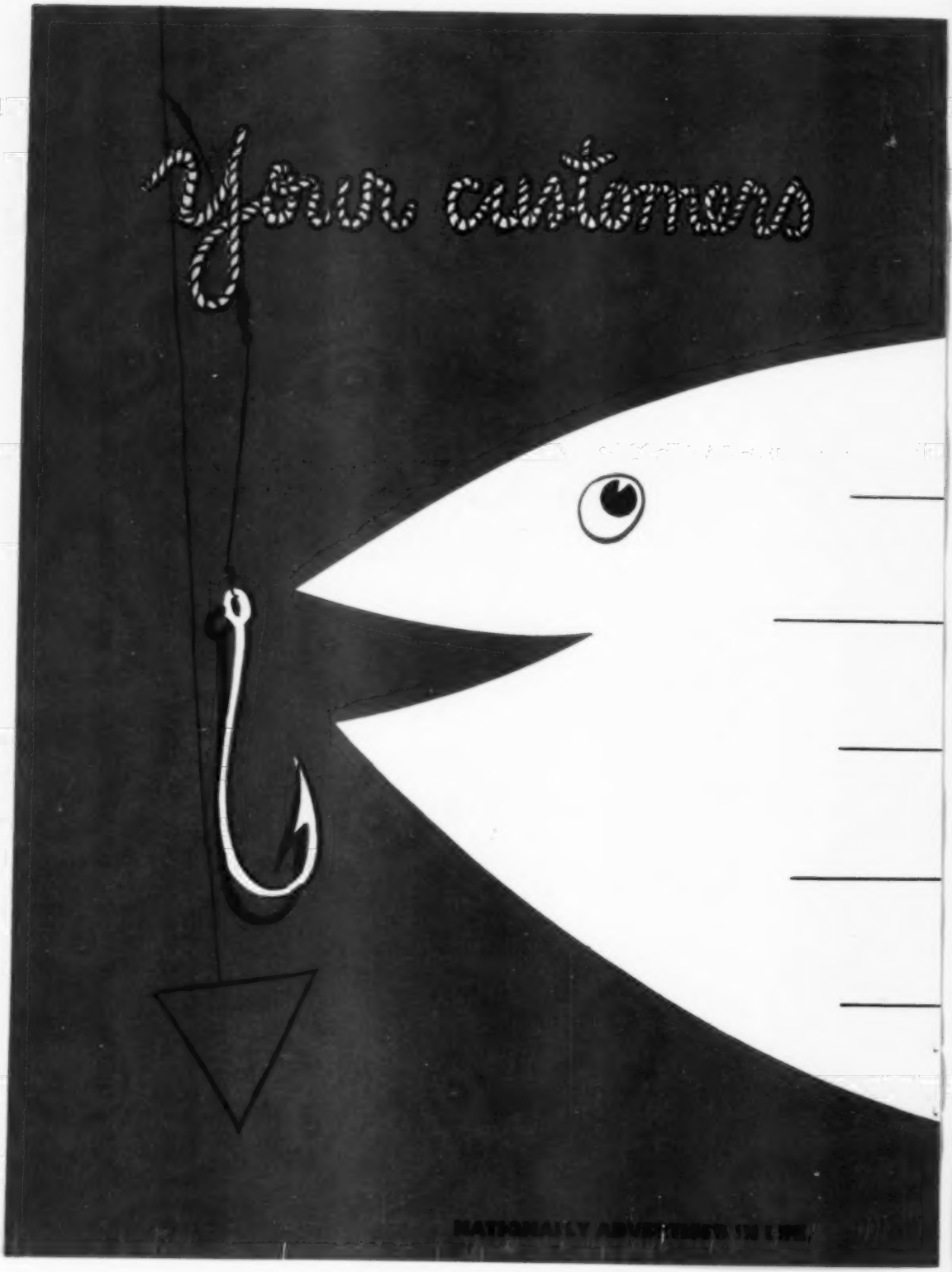
Technical Service
Free technical service without obligation! A technical service designed to consider and advise you and your customers on problems of insect and weed control, is available to you without cost and obligation from Colorado .44.
Local Advertising
Consistent, hard-hitting campaigns in your areas supplement Colorado .44 large scale national advertising, and help presell the customer and make dealer sales and dealer profits soar!
Folders
For your convenience, Colorado .44 has available many sales-stimulating folders and brochures.
Bulletins
Informative, "easy to read," technical bulletins on virtually all phases of insect and weed control are available to you and your customers.


Your customers

go for the 1952 Colora

TOXAPHENE
For better, more economical control of a wider variety of agricultural pests, we suggest Colorado .44 Toxaphene in various combinations and formulations. Colorado .44 Toxaphene is especially potent when used against grasshoppers, alfalfa weevils, armyworms, cutworms, lygus bugs and a variety of cotton pests.

BHC
If you're in the market for a profitable item for effective control of cotton and livestock pests, don't overlook Colorado .44 BHC. Show the farmers how they, too, can reap greater benefit through Colorado .44 BHC.

LIVESTOCK SPRAY
To stop livestock weight losses resulting from ticks, lice and flies, recommend Colorado .44 Gold Star Barn and Livestock Spray to your customers. It's the best solution for adding pounds to cattle and other livestock, because it eliminates the annoyance of weight reducing pests. Mixes easily in hard or soft water.

CHLORDANE CONCENTRATE
For the customer who prefers to mix his own solutions, suggest Colorado .44 Chlordane Concentrate. Extremely economical, yet effective for grasshopper, alfalfa looper, armyworm, and many other insect pests.

COTTON DUSTS
Here are more Colorado .44 products which can be applied with airplane, ground or hand equipment. Colorado .44 Cotton Dusts—in all formulations and combinations—are highly effective against boll worms, cotton leaf worms, boll weevils, thrips, and other cotton damaging bugs.

PARATHION
Recommend Colorado .44 Parathion. This versatile insect killer destroys the *green bug* in wheat and all small grains. Carry Colorado .44 Parathion and make your profit and the farmers' income greater. Also unusually effective against aphids, armyworm, citrus scales and many other destructive insects.

DAIRY SPRAY
Profit-eating livestock pests die fast when Colorado .44 Dairy Spray is used. This powerful insect killer will not harm cattle or humans if used as directed. It's a fast seller, and is fully approved by the USDA for use on dairy cattle. Non-toxic, non-injurious to livestock, poultry and warm blooded animals when used as directed.

ALDRIN
Here's a versatile, fast-moving item which will sell because of its effective action against boll weevils, grasshoppers, locusts and many other destructive pests. Colorado .44 Aldrin features quick action, low-dosage ease of use, economy.

2,4,5-T
For the elimination of heavy brush, there's completely effective control to be found in Colorado .44 2,4,5-T. Available in many combinations to meet any kind of control desired. Colorado .44 2,4,5-T offers sure elimination of mesquite, scrub oak, stumps and other heavy brush.

DDT
Sell widely used Colorado .44 DDT to farmers and watch your profits soar! This is a particularly profitable item to sell in the corn belt because of its effective control of the *European Corn Borer*. Also can be used for high percentage kill of the alfalfa weevil, lygus bug, and countless other destructive insect pests.

LINDAN
For sure
fleas on
.44 Lind
the ours
controllii
also for
agricultu
hoppers

CHLOR
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2,4-D
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of solut

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100% p
lice, thu
Can be
add a 7
Dust to
kills cat
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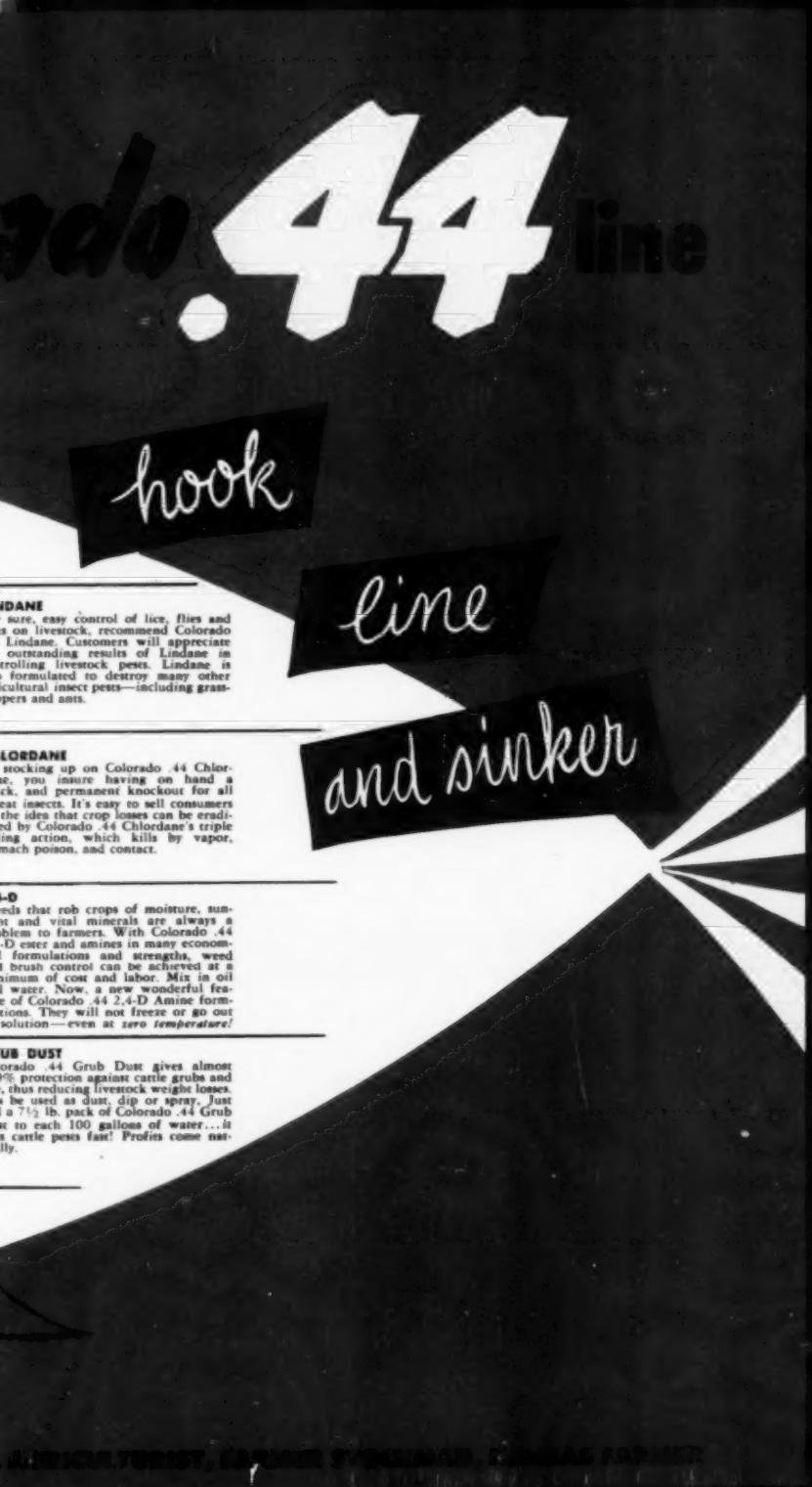
COUNTRY GENTLEMAN, SUCCESSFUL FARMING, FARMER'S FARM & HOME AND SO. A


.44 line
hook
line
and sinker
NDANE
sure, easy control of lice, flies and
s on livestock, recommend Colorado
Lindane. Customers will appreciate
outstanding results of Lindane in
trolling livestock pests. Lindane is
formulated to destroy many other
icultural insect pests—including grass-
ppers and ants.
LORDANE
stocking up on Colorado .44 Chlor-
ne, you insure having on hand a
ck, and permanent knockout for all
eat insects. It's easy to sell consumers
the idea that crop losses can be eradi-
ed by Colorado .44 Chlordane's triple
ing action, which kills by vapor,
mach poison, and contact.
-D
eds that rob crops of moisture, sun-
t and vital minerals are always a
blem to farmers. With Colorado .44
-D ester and amines in many economi-
formulations and strengths, weed
brush control can be achieved at a
imum of cost and labor. Mix in oil
water. Now, a new wonderful fea-
e of Colorado .44 2,4-D Amine form-
tions. They will not freeze or go out
solution—even at *zero temperature!*
UB DUST
orado .44 Grub Dust gives almost
% protection against cattle grubs and
, thus reducing livestock weight losses.
be used as dust, dip or spray. Just
a 7½ lb. pack of Colorado .44 Grub
to each 100 gallons of water...it
cattle pests fast! Profits come nat-
lly.

Specialized products make up the '52 Line!

COTTON SPRAYS AND DUSTS

SPRAYS—Colorado .44 manufactures 9 varieties of Cotton Spray Concentrates. In all combinations—Aldrin, DDT, Dieldrin and Sulphur.

DUSTS—Colorado .44 formulates many combinations of Cotton Dusts, including those with Sulphur, DDT, Toxaphene, Dieldrin, Aldrin and BHC.

AIRPLANE SPRAYS AND DUSTS

Colorado .44 manufactures 153 products especially compounded for airplane application. Included are:

- Aero Butyl Ester 2,4-D
- Super "80" Butyl Ester 2,4-D
- Super Chlordane Concentrate
- Super Toxaphene Concentrate
- Super Parathion Concentrate
- Super Aldrin Concentrate
- Aldrin Equivalent Oil Concentrate

CORN INSECTICIDES

Colorado .44 DDT formulations provide *SURE* protection against corn borers and other destructive and costly corn insects. For greatest sales and increased profit, feature the following:

- DDT-Emulsion Concentrate
- DDT-Wettable Powder
- DDT-Dust Concentrate

These, and other Colorado .44 insecticides are available for you today!

ALFALFA INSECTICIDES

Recommend these Colorado .44 products to farmers for faster knockdown, faster kill, and longer lasting killing power of destructive alfalfa insects.

- Aldrin
- Emulsifiable Chlordane Concentrate
- Super Chlordane Concentrate
- Emulsifiable Toxaphene Concentrate
- Super Toxaphene Concentrate

Stock up on these, and other alfalfa insecticides now for maximum profit.

CATTLE SPRAYS AND DUSTS

Control of weight-reducing livestock and dairy pests is becoming a bigger problem every year for farmers and cattlemen. Show them how they can control these pests with the following Colorado .44 products:

- Gold Star Livestock and Barn Concentrate
- Stock and Barn Insect Killer
- Dairy Spray
- Grub Dust
- Ben Hex 12 Wettable Powder
- Sheep Dust
- Lindane
- Rotenone

HOUSEHOLD PRODUCTS

A complete household insecticide and weed killer line is available for stock. These heavily promoted items are profitable to handle, because they sell fast and really do the job. The Colorado .44 household line is as follows:

- Colorado .44 Bug Killer
- Colorado .44 Ant and Roach Killer
- Colorado .44 Garden Spray
- Colorado .44 Garden Duster
- Colorado .44 Rid-O-Weed
- Colorado .44 Chlordane Concentrate

WEED KILLERS

This line-up of highly effective Colorado .44 weed and brush killers, is a guaranteed sales producer. Made of the finest tested formulations, they really do the job—and produce the profit.

- Butyl Ester 2,4D 40%
- 2,4-D Weed Killer Liquid Amine Concentrate
- Super "80" Butyl Ester 2,4-D
- Aero Butyl Ester 2,4-D
- Isopropyl Ester 2,4-D
- Super "80" Isopropyl 2,4-D
- Brush Murder
- Hi-Strength Brush Murder
- 2,4,5-T Concentrate
- Butyl Ester Brush Killer

WHEAT AND SMALL GRAIN INSECTICIDES

This coming season promises an unusually dangerous invasion of wheat and small grain insects. Help the farmer prepare for these destructive pests, by having on hand an adequate supply of Colorado .44 small grain insecticides. The following Colorado .44 products provide high kill, lasting control of aphids, red spiders, thrips, and *green bugs* in wheat and small grain.

- Parathion 25% Wettable Powder
- Parathion Dust 1%
- Super Parathion Concentrate

EARN MOR
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orado 44

INSECTICIDES
AND
WEED KILLERS

CALL THE PROFIT NUMBER:

AComa 5895

DENVER, COLORADO

COLORADO 44 BRAND

ORATION OF COLORADO
Denver, Colorado
P. O. Box 777

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Superior Termite Co.
BALD KNOB
Collison & Co.
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Ft. Smith Warehouse Co.
GRADY
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Mack Bros.
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PARKIN
Ed McNight Cotton Oil Co.
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RUSSELLVILLE
Pope County Farmers Assn.
SHERRIL
E. L. Burgess
SCOTT
Robert L. Dortch Seed Farm
WILMET
Wms. De Yamprt Merc. Co.

COLORADO
AGATE
Reed Oil Co.
AKRON
Williams Impl.
ALAMOSA
Farmers Warehouse Supply
ARRIBA
Kemp Service Station
BERTHOUD
Scheirerman Impl.
BRUSH
Hartwig Hardware
CHEYENNE WELLS
S. S. Cobb Impl.
DEERTRAIL
Milburn, Inc.
DENVER
Bartoldes Seed
Colorado Tora Co.
Denver Fire Clay
Rocky Mountain Seed Co.
Sears Roebuck Farm Store
Snowy Range Feed Co.
Western Seed
DERBY
Central Livestock Produce
EADS
Eads Impl. Co.
Terrell Grain Co.
FT. COLLINS
Kroll & Shannon Co.
FT. MORGAN
Northeast Seed Co.
GREELEY
Schank Feed Co.
HAXTUN
Miller Impl.
IDALIA
Bronner Hardware
KIOWA
Ralph B. Maul Feed Store
LA JUNTA
La Junta Milling & Elevator Co.
LAMAR
Brayles Farms
Colorado-Kansas Seed Co.
Orr Impl.
Prowers Store
LONGMONT
John P. Murphy Impl.
LOVELAND
Garrett Motor Sales
MATHISON
Minneapolis Moline Dealer
MONTE VISTA
Bechtel Drug
J. N. Jenson Weed Spray
PUEBLO
Hutchinson Pest Control
Sears Roebuck Farm Store
SIMLA
Engels Pharmacy
Pfost Standard Service
SPRINGFIELD
Farm Sales Co.
TRINIDAD
Quitach Impl.
WATKINS
Henderson E. Colfax Airport
Schmidt Machinery
WILEY
Ewing Milling Co.
WRAY
H. Dean Henry Drugs
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Wages Impl. Co.

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Pacific Garden Supply
BURLEY
Roundy & Holmes Skyways
DOWNEY
Elmo A. Gray
FRUITLAND
Chaney Wholesale Co.
IDAHO FALLS
Morgans
Rogers Farm Store
PARIS
Shepard Hardware
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Preston Supply
SODA SPRINGS
Bob Arnold Ag. & Weed
TWIN FALLS
Dingle & Smith Seed
Magic Valley Aircraft

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AGRA
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as the wetting agent

For a low cost wetting agent that vastly improves the emulsifying, spreading and sticking properties of sprays—there's nothing like NACCONOL. You keep costs low and you boost the killing power of the toxic agents in your formula.

As little as ¼% to 1% NACCONOL is all you need add to wettable DDT, BHC, 2,4-D, Chlordane, Sulfur and similar products and mixtures. Results are instantly observable in increased coverage and wetting which means a better kill.

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Monsanto has published a poster, entitled "Handle Parathion Safely," that should hang on the walls of every formulator, user, in fact anyone who handles this modern insecticide. It is being offered as part of Monsanto's program of furthering and expanding the use of agricultural chemicals by encouraging their *safe handling*. You can have a copy of this poster *free*. Request one by letter, card or coupon.

Niran, Monsanto's parathion, a relatively new, highly toxic insecticide, can be handled as safely as any of the older pesticides, if instructions on the poster are followed.

Niran (di-ethyl p-nitrophenyl thionophosphate) has been proved effective in four years of use in combating aphids, mites, caterpillars, beetles and scales. It can be applied as sprays, dusts, dust suspensions or aerosols.

If parathion is in your line of agricultural chemicals, we have two suggestions for you. First, mail the coupon for a copy of the new Monsanto poster and for literature on Niran. Second, contact the nearest Monsanto Sales Office and make arrangements for your 1952 Niran while supplies are available. MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 South Second Street, St. Louis 4, Missouri.

Niran: Reg. U. S. Pat. Off.

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NIRAN
(parathion)

MONSANTO
CHEMICALS—PLASTICS

MONSANTO CHEMICAL COMPANY
Organic Chemicals Division
1700 South Second St., St. Louis 4, Mo.

Without cost or obligation to me, please send materials indicated.
.....Parathion poster. .....Bulletin No. O-52, "Niran."

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Improve
your insecticide
with
Alcoa Cryolite
Alcoa Cryolite is a standard, high-power insecticide, approved by state experiment stations. It is compatible with insoluble-type copper compounds, sulphur and other neutral fungicides, insecticides and diluents. Its properties are dependable and can help make your insecticide better.
Here's how—
Alcoa Cryolite is Selective. Kills harmful, chewing insects, but has no appreciable effect on bees and other beneficial insects. Does not kill birds or other wild life.
Alcoa Cryolite is Safe. Does not affect soil balance. Safe on delicate foliage. Not acutely poisonous to humans.
Particle size is Uniformly-controlled. Just right for maximum, even coverage. High suspendability in spray tank. Free dusting and spraying.
Particles are Smooth. Negligible abrasive effect on equipment. No jagged edges, because particles are not formed by crushing.
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COOPER EMULSIFIERS

Save 25% to 50% On Emulsifier Costs

Improve Your Insecticide Formulations

Now available! A new series of emulsifiers that increase the efficiency of your formulations while using less emulsifier per gallon of concentrate. Nothing in the field today can equal the versatility of COOPER EMULSIFIERS, all tried and proven by actual large scale field use.

COOPER ATX-60: (Pat. Pending)
For optimum performance in Toxaphene, Toxaphene/DDT, Aldrin and Dieldrin systems.

COOPER BCX-70: (Pat. Pending)
For optimum performance in BHC, BHC/DDT and Lindane systems.

COOPER CTX-54: (Pat. Pending)
For optimum performance in Toxaphene, Toxaphene/BHC, and Toxaphene/Lindane systems when unusual excellence of performance in dipping vats over long periods of time is required for livestock application.

Test...Check...Compare These Important Advantages

1. Spontaneous dispersion.
2. Suspension power.
3. Emulsion stability.
4. Effective in hard and soft water.
5. Perform with either aliphatic or aromatic solvents.
6. Reduce emulsifier requirements—less emulsifier required per gallon, thus reducing costs.
7. Versatility—each emulsifier gives optimum performance in many systems, thus reducing inventories.
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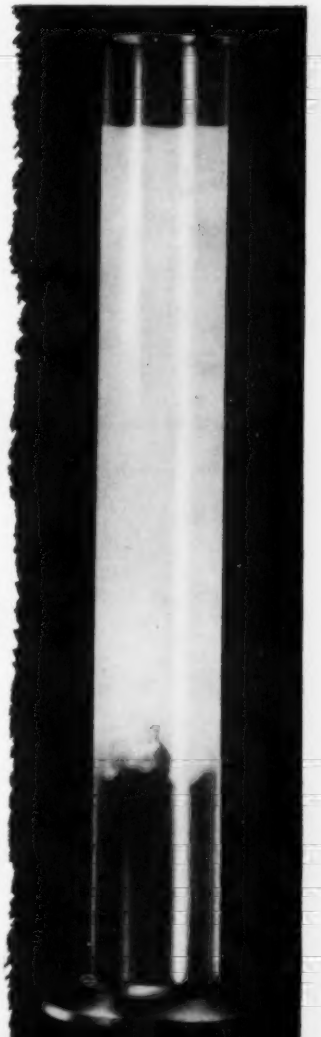

Actual photograph 6-lb. Toxaphene Gal. containing 3% Cooper Emulsifier ATX-60.

Samples...together with specification and formulation sheets, will be promptly sent upon request.

COOPER DEPENDABLE PRODUCT

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Please send free samples, and complete information about COOPER EMULSIFIERS.

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AGRICULTURAL INSECTICIDES

PARATHION

25% EMULSION

25% DUST BASE

15% WETTABLE POWDER

TEPP-40

TETRAETHYL PYROPHOSPHATE

ALDRIN

EMULSIFIABLE CONCENTRATE

DUST BASE

B H C

12 GAMMA

36 GAMMA

DIELDRIN

EMULSIFIABLE CONCENTRATE

DUST BASE

D D T

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WETTABLE POWDER
DUST BASE

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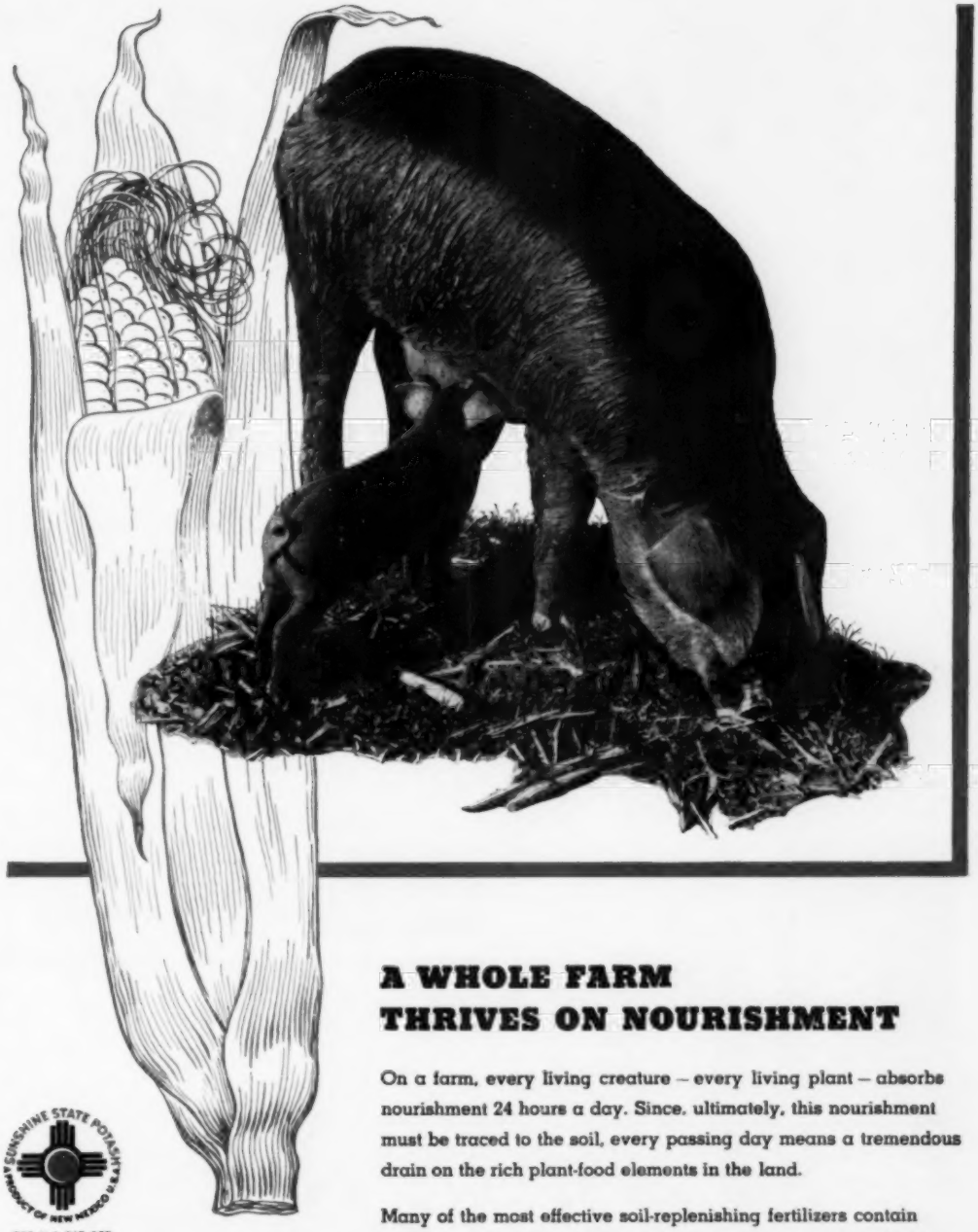

A WHOLE FARM THRIVES ON NOURISHMENT

On a farm, every living creature – every living plant – absorbs nourishment 24 hours a day. Since, ultimately, this nourishment must be traced to the soil, every passing day means a tremendous drain on the rich plant-food elements in the land.

Many of the most effective soil-replenishing fertilizers contain POTASH . . . often Sunshine State Potash, a product of New Mexico. Such fertilizer is more than a mere soil nutrient. It strengthens the crops . . . effectively helping them to resist disease and drought.

SUNSHINE STATE POTASH
PRODUCT OF NEW MEXICO

REG. U. S. PAT. OFF.

HIGRADE MURIATE OF POTASH 62/63% K_2O
GRANULAR MURIATE OF POTASH 48/52% K_2O
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Protection that won't rain away

ARMOUR STICKER helps protect this valuable crop when it needs protection most!

Just after rainfall, insects are very active — and plants unprotected. The usual insecticides are washed away by rain, to the point where they fail to do their job. The crop is completely open to damage. That is, unless you use Armour STICKER.

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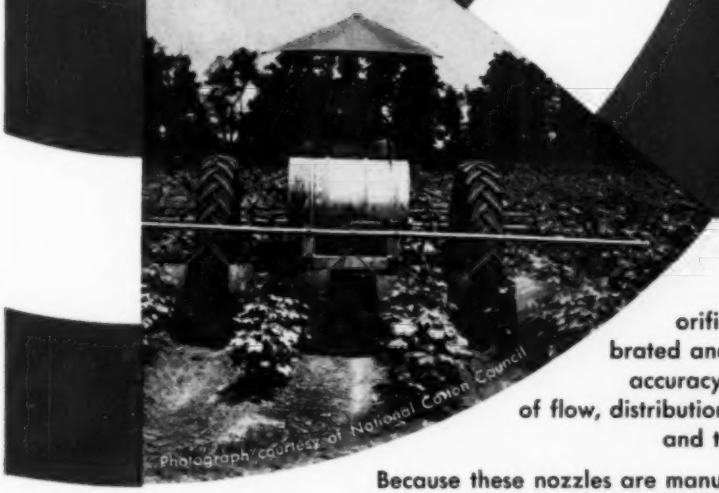

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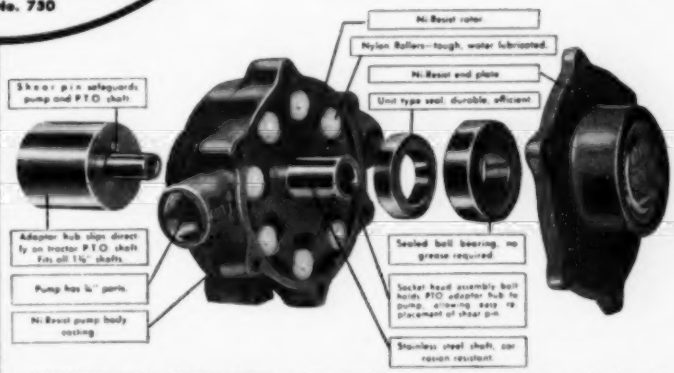
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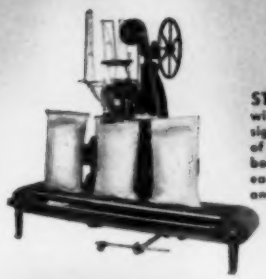
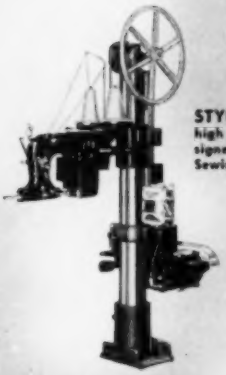
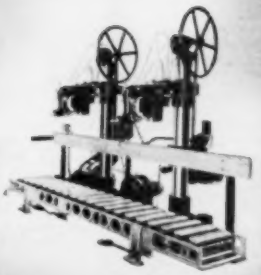


STYLE 21800 H *(Left)*, equipped with 80600 H sewing head, is designed for fast, economical closing of paper bags. Bag is sewed, tape-bound, and tape is cut off neatly at each end of closure. Sewing head and conveyor adjustable vertically.

CLASS 20500 *(above)* machines are heavy duty, high production units for closing medium and heavy weight bags. Available with power-driven horizontal conveyor, inclined conveyor, or both; or with conveyor transmission unit only, for plant production line.



STYLE 20100 H *(left)*, is a heavy duty, high production column type machine designed for use with plant conveyor systems. Sewing head is pedal controlled.



DUPLEX MACHINES *(right)* are designed for closing double bags. The first sewing head closes the inner bag; the second closes either the outer bag alone, or both bags together for extra safety. Also recommended for single closures where continuous operation is a must — operator can instantly switch to other head.

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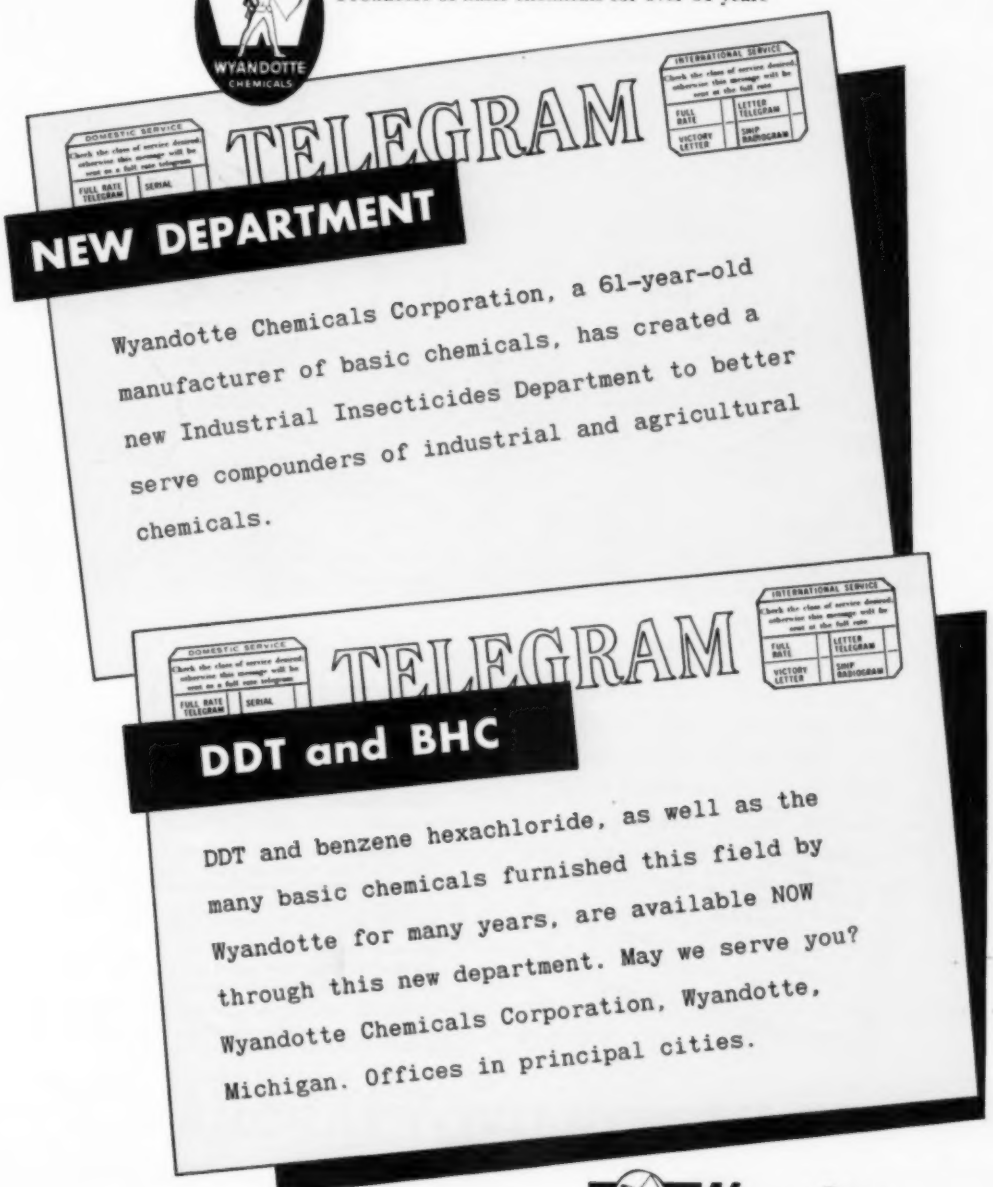
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The farmer knows that careful soil preparation is mighty important in growing finer crops. And he knows, too, that it takes careful preparation to make reliable agricultural chemicals. That's why so many growers depend on Ashcraft-Wilkinson, makers of fine chemical products since 1911.

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Because Aldrin compounds are sprayed or dusted from the ground or from planes, effective coverage is quick and easy. No wonder growers in many sections are insisting on the insecticide that "kills the mostest with the leastest!"

Now Aldrin has a partner—Dieldrin—equally lethal and economical. Dieldrin is recommended for all applications requiring residual action. It goes on killing . . . longer.

Aldrin and Dieldrin are tested, proved and officially approved for cotton insect control. Experiments now under way promise a new conception of control for other pests—from flies and mosquitoes to ants and termites. See your agricultural distributor for the latest on Aldrin and Dieldrin.

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Guest Editorial Written Especially for This issue of Agricultural Chemicals

West Coast Extends Welcome to NACA

by

William E. Ball

Stauffer Chemical Co.,
San Francisco;
President, Western Agricultural Chemicals Association

THE National Agricultural Chemicals Association is being welcomed to San Francisco for its spring meeting, April 6-9. It is particularly fitting for California to be the host to this influential group party, because this marks the Association's first meeting on the West Coast in more than 15 years, but also because of the increasing importance of chemicals in agricultural production in this section of the country.

The main hub for the NAC meeting is the Fairmont Hotel, located high atop Nob Hill in San Francisco, overlooking the city, San Francisco Bay and the Pacific Ocean. West Coast NACA and WACA committees and members have arranged a meeting that will offer members and their wives both scientific information and social enjoyment. San Francisco itself with its famous cable cars, Golden Gate and Bay Bridges, and other equally well known spots, offers unique charm and entertainment for all those attending.

Since science has become an integral and important factor in the American way of life, it is natural that the spring meeting will afford opportunity for the exchange of information so vital to increased agricultural production. Well-known speakers are scheduled to discuss main subjects of interest before the Association and the informal discussions will further increase and diffuse agricultural chemical knowledge.

Scheduled speakers include: Mr. Joseph B. Cary, executive vice-president, Food Machinery and Chemical Corp., San Jose, California; Mr. William R. Allstetter, deputy director, Office of Materials and Facilities, PMA, U S D A; Dr. G. F. McLeod, technical vice-president, Sunland Industries, Inc., Fresno, California; Dr. Stanley Freeborn, Dean, College of Agriculture, University of California, Berkeley, Calif; Mr. W. C. Jacobsen, assistant to the director, Department of Agriculture, State of California, Sacramento, California; Dr. A. M. Boyce, director, Citrus Experiment Station, University of California, Riverside, California; and Mr. Chester B. Moore, managing director, Western Growers Association, Los Angeles, California.

The part science has played in changes that have taken place in farming methods and crops during the past thirty years is nothing short of spectacular. Agriculture as an industry has changed from drudgery and isolation,

(*Turn to Page 119*)

THE EDITOR COMMENTS

THE curtain seems about ready to rise on the final act in the epic Delaney production. The Select Committee which has finally completed an eight-month investigation into the use of chemicals on foodstuffs is apparently about ready to announce its recommendations. Mr. Delaney, in a brief statement in this issue of AGRICULTURAL CHEMICALS, indicates he is of the opinion that "some new legislation dealing with the addition of untested substances to foods should be enacted." (Story faces p. 118) In a press interview he is reported as having stated that the committee would be "inclined toward recommending something along the lines" requested by the Food and Drug Administration.

Disregarding testimony from many informed witnesses that there is already ample legislation on the books, which needs only to be enforced, the Delaney Committee has apparently determined that they will not abandon what is every Congressman's prerogative, — the fathering of still more new laws. Just as in the Army the watch word is "If it don't move, paint it," so in Congress there is one standard treatment, "pass a new law."

Probably new legislation is inevitable, since it would be a hardy committee that could be expected to spend this much time and money on any problem without recommending at least one new law. It is to be hoped, however, if new legislation is offered, that the committee will differentiate in its thinking between agricultural insecticides and fungicides on the one hand, which are used of necessity in crop production, and food additives, drugs, cosmetics, etc., which in most cases can be used or not used as a matter of choice. Separation of the two types of materials, and the controls to be exercised over them, is essential in any reasonable control program.

The impression has somehow been built up in the public mind that no controls exist to control the marketing and use of pesticides. Actually, as W. W. Sunderland of Dow Chemical Co., pointed out in a recent address (See pg. 41) "nothing is further from the truth. The pesticide industry is one of the most, if not the most highly regulated industries in this country." Historically, this regulation has been under the Department of Agriculture, with a long record dating back to the Insecticide Act of 1910. If the Delaney Committee now feels that more protection is necessary, it would seem to be quite logical to refer the subject back to the House Committee on Agriculture for additional recommendations, but we question very seriously the logic of shifting responsibility from the Department of Agriculture which has done a capable job of regulating the use of insecticides and fungicides for over forty years.

A BASIC belief in private industry's ability to do a dependable job of production is indicated by the U. S. Department of Agriculture's recent arrangement for a fast tax-write-off on ten new nitrogen plants. Agriculture needs more nitrogen for fertilizers and the world needs the extra food and fiber to result from such application.

It has always been axiomatic that private industry can produce materials better, faster and much cheaper than can government-operated plants. Now, in the case of nitrogen production, the industry is showing a willingness to risk dollars and cents to prove that if allowed to operate economically, without endless government red tape, it can produce in a manner to vindicate the traditional American way of doing things.

Our bet is that once these ten important plants are in production, the supply of extra nitrogen will be both large and continuous. The U. S. Department of Agriculture which for a long time has been anxious to assure a greater supply of nitrogen, is to be commended upon its wisdom in choosing this method of accomplishing the end. Private industry has been sitting at the door waiting for such an assignment for a long time. Now that the opportunity has come, we expect to see production under way well within the time limits set forth.

Pesticide Controls Adequate;

Present Laws Indicate

No More Legislation Needed

by

W. W. Sunderland*

Dow Chemical Co.
Midland, Mich.

MANUFACTURERS of products used in agriculture for the control of insects and plant diseases and to a certain extent external diseases of livestock, are on the offensive in the continuing struggle against those pests and plant diseases which affect adversely the production of foodstuffs of all kinds.

Despite this positive position, the industry is also on the defensive by reason of attacks from those who charge that pesticides, food additives and fertilizers are poisoning the public. Credence is given to those who insist that such materials are unnecessary to the production of food. It is hoped, of course, that this has been proved fallacious for all time by the hearings held by the Food and Drug Administration for the purpose of establishing residue tolerances for necessary additives to foods.

More recently, the Delaney Committee has been holding hearings to consider the broader aspects of chemicals in foods, and by recent extension of scope, in cosmetics and similar products. The conduct of these hearings and the way they have been reported in the public press have given the general impression that no controls exist to govern the marketing of chemicals in general and pesticides in particular. It is, of course, the manufacturer, the "greedy corporation," who is the prime target in these attacks. Apparently, it is presumed that we in industry eat no food ourselves and are so foolish as to expect to expand our business by the poisoning of our customers.

Actually, nothing is further from the truth. The pesticide industry is one of the most, if not the most, highly regulated industries in this country. Laws directly affecting the labeling, distribution and sale of these agricultural pesticides exist at the federal, as well as at state levels, most of them requiring registration or other clearance with enforcement officials before they may be legally sold, and involving the payment of fees aggregating many thousands of dollars annually.

The agricultural chemical industry has long recognized the need for and desirability of effective regulation, and has cooperated actively in the drafting of federal and state statutes, opposing only those which appear to be unjust, unnecessary or unduly restrictive. Also it has fought where necessary to maintain conformance to the overall uniformity of regulation in order to do business on a nationwide scale without the manifold difficulties arising from conflicting requirements.

To this end, the industry cooperated to the fullest extent in the drafting of the Federal Insecticide, Fungicide and Rodenticide Act so that it might serve as a national pattern, and then worked with the Council of State Governments to draft a model state law which would duplicate the requirements of the federal law with those changes embodied which are necessary because of the different requirements for state legislation. It has been most gratifying to see this model law adopted by many states which have added statutes of this kind to their codes.

Basically, these laws define what constitutes a pesticide—usually insecticides, fungicides, rodenticides, and herbicides, more recently plant growth control agents such as defoliants and products for limiting preharvest drop of fruit. Labeling requirements including directions for use, necessary warnings to prevent injury to crop, host plant, operators, beneficial insects and the like, a statement of ingredients and net contents are specified and it is made unlawful to transport, sell, offer for sale or barter or give away any product adulterated or misbranded in any way. Usually registration and filing of labels is required before sales may be made.

* From paper presented at meeting of American Association of Economic Entomologists, Cincinnati, Ohio, December, 1951.

One controversial provision of the federal act is that which permits registration under protest, that is should the enforcing official be unwilling for any reason to grant registration, the registrant, believing such action unjustified may require issuance of a registration under protest, thereby permitting him to sell, and at the same time subjecting himself to greater penalties if, in fact, he is later proved to be in the wrong. This provision was intended as a protection against unwarranted and arbitrary action by an enforcing official and at the same time to give him some relief from responsibility in case of an honest difference in interpretation of data submitted to substantiate claims made for a product. While originally the Federal officials were heartily in favor of this provision, Dr. Griffin, Asst. Chief of the Insecticide Division has testified before the Delaney Committee that his department now feels it is a potential weakness in the Federal Act. We believe that the record does not substantiate this. Of the thousands of registrations processed in Washington, a scant half dozen or so were registered under protest and only one, involving no question of harmful residues, was actually marketed. This provision still appears to be both good and necessary, even if it should act as nothing more than a threat to both official and applicant and thus cause them to adjust their differences.

It should be noted that at the time of application, the applicant must submit data substantiating claims for a product, its safety on the plant to which it is to be applied, and its safety to humans, livestock, bees and valuable insect life. It is at this point that entomologists and phytopathologists become involved, since it is from these sources that much of this information must come.

Active control over improper use of pesticides is also exercised by the Food and Drug Administration through provisions of the Federal Food, Drug and Cosmetic Act which prohibit interstate transportation of food which contains poisonous or deleterious materials which may render it injurious to health except where such materials are necessary to the production of the food or cannot be avoided in food manufacturing practice. In the latter case, provision is made for the Federal Security Administration to hold hearings to establish residue tolerances which are consistent with safety to the public health. It follows, that if such safe tolerances are impossible to achieve, then the tolerance must be zero. No grower would be so foolish as to use a pesticide product which by leaving an excessive residue would subject his crop to seizure and destruction.

Finally, at the federal level, the Federal Trade Commission exercises control over advertising which prevents extravagant claims and misleading information of similar sort. And in addition, the Insecticide Division likewise has a measure of control over advertising through their regulations which define as labeling any advertising making claims different from those which are approved at the time of registration.

Turning now to the states, it has been pointed out already that a majority of them have laws paralleling the Federal Act and thus control products which may be sold only within the boundaries of a single state and which are, therefore, not subject to federal action. The greatest divergence from the Federal law occurs in the definition of the ingredient statement. The Federal law permits either a statement of the name and percentage by weight of each active ingredient plus a statement of total inerts, or a listing of *all* ingredients, active and inert, arranged in the descending order of amount in which each is present, plus a statement of total inerts. Some states permit only the first alternative. This works no hardship on the agricultural pesticide manufacturer since he normally adopts this method of statement to permit identification and utilization of his products in terms of pounds of actual active ingredient in accordance with the recommendations of the state experiment stations.

In certain states, poisonous pesticides are regulated by pharmacy and poison laws. Fortunately, it is usually recognized that the sale and distribution of pesticides is an entirely different operation from that of selling small prescription packages. Most laws specifically exempt materials used in the arts and sciences from the provisions of such laws, since labeling requirements of the pesticide control statute coincide with those of the poison laws respecting labeling with the word "Poison," the skull and cross-bones vignette, and an antidote statement. In only one state does the law still require that a pesticide dealer employ a registered pharmacist to handle the sale of these products.

Application Laws

THE above has outlined existing controls over the distribution of pesticides. It shows clearly how unjustified is the current agitation for more legislation, since present laws are adequate. We now turn to a different type of legislation, that concerning the application of pesticides. The fact that many changes have come about in the pesticide trade in recent years is too obvious to repeat here; but the introduction of new materials, new methods of application and the development of the custom application business have combined to create new problems requiring new regulations to protect the public and at the same time to make legitimate an important service industry.

The organic chemist has turned out a great number of valuable materials and his search for new ones continues. These new materials present an entirely different hazard to operators, livestock, other crops and even to innocent bystanders. Failure to recognize this has resulted in some accidents which in turn has resulted in a demand for legislation to prevent the recurrence of such accidents. Here again industry recognizes that some form of regulation is required by the hazardous nature of these newer products and by the failure on the part of the user, to read and heed warnings printed on labels and in literature. That industry is not unmindful of these hazards is seen in the prodigious amount of work being done to educate users in the handling of these newer products. Industry is

working to find all the possible hazards, to anticipate the possibilities and results of misuse and in fact, to evaluate the over all results from the use of such products. But it is impossible for industry to police all of its customers, hence, the police power of the state must also intervene.

The application of pesticide products by airplane and the newer type of spraying and dusting equipment has raised specific problems in respect to confining application to the intended area and avoiding drift to inhabited areas or to crops which may be damaged by the material being applied. Failure to recognize these hazards or to heed them has unfortunately had some bad effects, with the injured seeking protection and redress.

The custom applicator, too, has created problems, particularly the few of questionable integrity, who come in to an area, treat, and are gone tomorrow. The legitimate operator, who does his work well and who wants to stay in business and keep the good will and patronage of his customers has been the secondary victim of the shoe-string operator, whose improper approach has brought about regulation requiring licensing, examinations, permits, bonds and similar evidences of ability and knowledge to do a proper job.

Careless Use of 2,4-D

WEED killers of the 2,4-D type have also been responsible for a variety of laws regulating their labeling, sale and use. It is extremely unfortunate that careless use of such valuable materials by a few should have to subject the many to additional control and inconveniences.

Section 1080 of the Agricultural Code of the State of California offers an example of the type of regulation these various considerations have fostered. This code provides that "The director, after investigation and hearings shall adopt rules and regulations governing the application, in pest control or other agricultural operations, of any materials which he finds and determines to be injurious to persons, animals, or crops, other than the pest or vegetation which it is intended to destroy—." And further "It is unlawful for any person to apply any injurious material for which rules and regulations have been adopted as provided in this section without first having obtained from the commissioner a permit therefore."

Hearings were held as required and regulations adopted which say in part that certain arsenicals such as calcium arsenate when applied in dust form by machine-powered equipment, TEPP when applied in unconfined space as a thermal aerosol, Parathion and EPN are "injurious materials." Certain conditions and restrictions are imposed upon their use. Permits must be obtained to use them and records must be kept for submission to the Director of Agriculture. I need not detail the restrictive conditions imposed by the regulation. They involve such things as posting of notices in areas treated with volatile organic materials, warning all people known to be in the area to be treated, the prohibition of leaving contaminated containers about where they may result in injury to livestock, and the prohibition of dusting where wind velocity exceeds 5 miles per hour.

An interesting type of regulation has been recently enacted in the state of Oregon by which certain areas may be established as restricted or protected areas by vote of the growers in that particular section. Committees are then established to make in colaboration with the State Dept. of Agriculture whatever regulations are appropriate to govern the application of herbicides in that area and may even levy a tax to carry out the regulations adopted.

Of particular interest is Section 36 which provides that no action shall be commenced arising out of the use or application of any pesticide unless the claimant shall have filed a verified report of the loss with the department of Agriculture together with proof of service of such report on the pest-control operator allegedly responsible and the person for whom the work was done within 60 days after the loss occurred. If damage was to growing crops the claim must have been filed before 50% of the crop shall have been harvested. California has recently added a similar provision to its agricultural code. In Texas a recent revision of the Herbicide Control law prohibits use of certain weed killers except in areas to be established by the state where it is known that damage to crops will not result. This permits use of the 2,4-D type of material to improve rangelands but protects the cotton farmer from loss of his crop, which, of course, is one of the most susceptible to damage by 2,4-D.

There still seems to be considerable discussion as to the proper type of regulation of custom applicators. Most existing regulation requires the examination and licensing of such operators and their employees, the posting of bonds to assure a proper job and recompense for failure, the obtaining of permits and the keeping of records of jobs done, the prevailing air conditions at the time of application and the like.

Most of these laws are too new to tell just how they will work out in practice. Only time can tell whether they will accomplish their purpose.

In conclusion, current proposals to amend existing laws so as to give to certain governmental agencies arbitrary powers over the marketing of products intended for use in the production of foodstuff should be given very careful consideration. We believe that they are unnecessary in view of the formidable body of regulation already in existence. Sufficient properly qualified evidence has not been presented to show that this existing regulation is inadequate if its manifold provisions are fully utilized by enforcement officials.

It should further be borne in mind that research can go on forever without establishing all the factors which practical use of a product may eventually show up. A reasonable approach must be taken if progress is not to be seriously impeded. Some element of risk exists in practically everything we do today. A prudent man assays that risk and governs his action accordingly. In our development of new pest control measures and materials we can do no less, nor should we be required to do more.★★

A. W. MOHR
NACA President

Full program of important topics set for San Francisco meeting of NAC. Representatives of industry, state and Federal agencies appear on program as

NACA

Looks at Pesticide Problems for '52

MEETING on the west coast for the first time in some 15 years, the National Agricultural Chemicals Association was to hold its 1952 spring convention at the Fairmont Hotel, San Francisco, April 6-9.

The first day, Sunday, April 6, was to be devoted to committee meetings, with a reception for members from 5 p.m. to 7, at the hotel.

Opening Monday morning with the first general session, the NACA program was to include talks by vice-president Paul Mayfield, Hercules Powder Co., Wilmington, Del.; Arthur W. Mohr, California Spray Chemical Corp., Richmond, Calif., NACA president; and W. E. Ball, Stauffer Chemical Corp., San Francisco., president of the Western Agricultural Chemicals Association.

Following on the morning program were to be Joseph B. Cary, Food Machinery Corp., W. R. Allstetter, deputy director, Office of Materials and Facilities, Production and Marketing Administration, U. S. Department of Agriculture, Washington, D. C.; and G. F. McLeod, Sunland Industries, Fresno, Calif.

Tuesday morning's session was to be in charge of Lea S. Hitchner, NAC Association executive secretary, Washington, D. C. This session was to be restricted to members of the NAC and of the Western Agricultural Chemicals Association. Scheduled to appear on this program were L. Gordon Utter, Phelps Dodge Refining Corp., New York City; John Conner, Washington, D. C., NACA counsel; and Joseph A. Noone, NAC Association, Washington, D. C.

Tuesday evening's program was to consist of the annual banquet at the Fairmont, with Walter E. Ball as toastmaster. Entertainment was to be provided for the group.

Open sessions were to be resumed Wednesday morning with president Mohr as chairman. On this program, the advance schedule called for talks by Dean Stanley Freeborn, University of California, Berkeley; W. C. Jacobsen, assistant director of the California State Department of Agriculture; and Dr. A. M. Boyce director of the Citrus Experiment Station, Riverside, Calif.

The Olympic Club, Lakeside, Calif. was to be the site of a golf tournament with Ed. Schuler as chairman. Steamer tours of San Francisco Bay were being arranged by the Western Agricultural Chemicals Association which had also provided for transportation to and from the dock and for refreshments on board.

Mrs. Ed. Littooy was chairlady for the entertainment of visiting ladies in connection with the convention.

The arrangements committee, responsible for the smooth operating of the California convention, included the following. L. T. Kett, chairman, Mountain Copper Co., Ltd.,

PHOTO OPPOSITE PAGE

View of downtown San Francisco, with Fairmont hotel in center. To the right is the Mark Hopkins hotel; Bay bridge in the background.

L. S. HITCHNER

PAUL MAYFIELD

AL BOYCE

San Francisco; W. E. Ball, Stauffer Chemical Co., San Francisco; E. C. Cody, California Spray-Chemical Corp., Richmond; Elmer J. Davis, Los Angeles Chemical Co., Los Angeles; E. T. Doyle, Tobacco By-Products & Chemical Corp., San Farncisco; A. J. Flebut, Niagara Chemical Division, Food Machinery & Chemical Corp., Richmond; W. J. F Francis, Pennsylvania Salt Mfg. Co. of Washington, Tacoma; W. D. Gray, secretary, Western Agricultural Chemicals Association, San Francisco; David T. Prendergast, Dow Chemical Co., San Francisco; and Edward Schuler, Monsanto Chemical Co., San Francisco.

From Arsenic to Warfarin -----The Story of RODENTICIDES

RATS and mice have been associated with man for many centuries. They have followed him to all parts of the world, carrying with them certain human diseases, destroying property, and in general, interfering with man's economic and physical well-being.

That rats and mice are wary creatures is attested by the fact that even after generations of work in combatting them, we still have gained only mediocre control. It is true that if every one practiced proper sanitation—consisting of adequate refuse storage, collection, and disposal, the problem would be far more simple. Unfortunately, human nature does not allow for 100% cooperation on such a program. As a result, the mouse and rat problem has become almost an accepted menace. Many methods have been employed to keep rats and mice within the "accepted menace" range. It has been a matter of pitting the brain of man against the intelligence and sensitiveness of the rodent. This has not been an easy task.

Attempts have been made to kill rats in burrows with water, fire, carbon monoxide or cyanide gas. Other methods include glueboards, fumigants, shooting, clubbing, trapping, and the use of cats, dogs and ferrets. All of these have proved to be only partially successful in controlling rodent populations. No effective rat or mouse repellent is known; were one available, it would serve in many instances merely to scatter the rodents rather than to eliminate them. The methods mentioned above usually lend themselves to specific control problems. None has been particularly effective.

Rodenticides Effective

ONE approach which has been practiced for years and shown to be relatively effective is the use of rodenticides—particularly with reference to rats. Many poisons have been tried, each has one or more shortcomings. It must be remembered that the rat is an intelligent animal.

However, before proceeding with a discussion of rodenticides, it appears advisable to give consideration to the requirements of a good poison. It has been postulated that the ideal rodenticide should be a slow acting one. It should be odorless and tasteless and inevitably lethal in action. It should not produce symptoms of acute poisoning, thus causing bait shyness and requiring what is known as prebaiting. Death should be delayed to assure the necessary consumption of the bait by all the rats and the manner of death should be such that the surviving rodents will not become suspicious, but will continue to eat the bait until death. The poison should be specific for certain species, hence, not dangerous as regards man and domestic animals. There should be no sex, age, or strain difference. The rodenticide should not permit the building up of a tolerance in the pest.

These requirements are extremely rigid—a tough bill to fill.

White Arsenic First

AMONG the earliest rodenticides was arsenic trioxide As_2O_3 also known as white arsenic. This rodenticide must be a finely ground or micronized powder for best acceptability. It has a gritty taste which is readily detected by rats. It is slow acting, causes bait shyness, and is extremely poisonous to other animals.

Zinc phosphide (Zn_3P_2) is also a poison which has been used for many years. Unfortunately, it deteriorates rapidly, hence, baits treated with it are relatively non-toxic after a few days. Zinc phosphide is a black powder and has a distinctly disagreeable odor which, however, does not repel but may even attract rats. In these respects it is safer than some rodenticides in that its odor and color are objectionable to man and pets. However, in spite of this it is considered highly toxic to all forms of animal life to the extent that it is used in conjunction with emetics. The use of emetics with rodenticides is a common practice because the rat cannot regurgitate.

Thallium sulfate (Tl_2SO_4) is also an old rodenticide. It can be used in either water or food baits. It is a slow acting, cumulative poison. Furthermore, it can be absorbed through the skin, hence making it dangerous to handle. It is tasteless and readily accepted by rats, but it is not recommended for general use.

Another rodenticide which is still widely used because of its relative safety is red squill. It is obtained from the bulb of a lily-like plant that grows in the Mediterranean region. Its safety lies in the fact that red squill contains a naturally occurring emetic agent which causes the elimination of the poison by vomiting. Unfortunately, red squill, as imported, is not uniform in potency and, hence, measures

by

J. H. Krieger*

Wisconsin Alumni Research Foundation
Madison, Wisconsin

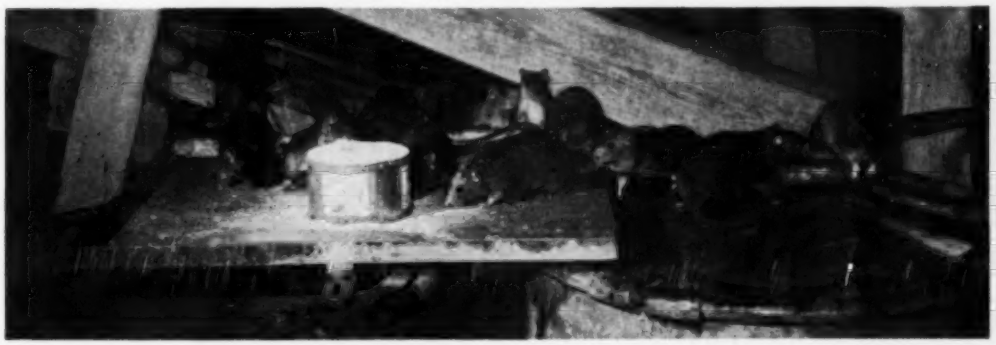
must be taken to fortify it with red squill extracts to produce a reliable rat poison. The product has a disagreeable taste and odor, requiring a prebaiting procedure. This consists of placing unpoisoned baits for several nights in the same places to accustom the rats to the bait. On a subsequent night, a lethal dose (10%) of red squill is added. Rats having eaten a fatal dose of red squill become lethargic within one or two hours, and from four to fourteen hours later exhibit characteristic tremors in the hind legs. This state is followed by paralysis of the trunk and forelegs, labored breathing, and a peculiar over and over rolling motion. This motion may continue from one-half hour to twenty-four hours before death. Death apparently is due to acute action on the heart or respiratory paralysis. Although red squill is considered one of the safest poisons, its effectiveness is reduced by these drastic symptoms of poisoning.

*Before the Section of Extension Entomology, American Association of Economic Entomologists, Cincinnati, Ohio, December 12, 1951.

(Above) Surprised by a flash camera, these rodents are caught helping themselves to residue in a feed trough. The rat population on farms is one of the most destructive factors in agriculture.

(Above) The effectiveness of properly-placed warfarin rodenticides is shown graphically on a farm where an "all out" program had been undertaken. More than 200 dead rats of all sizes are in this scene.

(Below) More evidence of the way rats swarm around food sources on the farm. Again the flash camera catches the rodents on a nightly tour. The can in the foreground contains warfarin bait, so most of these creatures weren't present on many more raids.



One of the rodenticides which is a war developed toxic poison is ANTU—alpha naphthyl thioureau or compound 109. Although this poison held great promise at one time it has fallen into disrepute in recent years. By experience it was found to be far more effective against the common grey or brown rat than against the roof rat—indicating a species difference in effectiveness. In addition, young rats have a greater resistance to ANTU than adults. Rats receiving sub-lethal doses of ANTU develop a definite tolerance. In fact, this tolerance seems to develop within a few hours and to persist for 30 days or more. ANTU causes a marked increase in lymph flow up to more than 80 times the normal rate. This is associated with an increase in permeability of the lung capillaries, leading to pulmonary edema. Death usually occurs within 48 hours. Although it is believed to have a low toxicity for man, it is extremely toxic to cats, dogs, hogs, and chicken.

1080 is Developed

ANOTHER rodenticide developed during the war is sodium fluoroacetate, more commonly known as 1080. It is considered a most effective rodenticide, but it is also among the most dangerous to all warm blooded animals. In fact, it is so toxic that its use is limited to licensed pest control operators and then in water baits only. It is a crystalline compound, odorless and tasteless and very soluble in water. It is fast acting, producing symptoms of poisoning in twenty minutes or less, and killing in one to eight hours. The poison is not cumulative nor do rats develop a tolerance to it. Acting chiefly on the heart, with a secondary effect on the central nervous system, 1080 usually causes death by heart failure following ventricular fibrillation. The effect on the central nervous system causes convulsions. It is effective in extremely small dosage, i.e., approximately ½ to 10 mgs./kg. in the rat and in even smaller doses for other animals. There is no known antidote for 1080.

Thus far we have mentioned only the more commonly used rodenticides available to the public shortly after World War II. There are several other rodenticides which could be mentioned as they are used on occasions. These include barium carbonate, phosphorous paste, plaster of Paris, and strychnine. These rodenticides, however, like those discussed previously, each have one or more undesirable features which have prevented their general use in rodent control work. In other words not one of these poisons fulfills all the requirements for the ideal rodenticide.

Warfarin Enters in 1950

THIS was the picture up to June 1950 when a new rodenticide, with a novel approach to rat and mouse eradication, was released for public use. This poison, called warfarin, was made available for public use after many years of research by a large number of both scientific and non-technical investigators.

The story of its discovery and the development of warfarin as a rodenticide is indeed a fascinating one. It has its beginning in the middle thirties when a farmer brought a pail of blood to the Department of Biochemistry at the University of Wisconsin. The blood was from one of several cows that were bleeding to death. He wanted to know what was wrong with the blood. Fortuitously, this farmer presented his problem to Professor Karl Paul Link, who as a research man, was very much interested in this problem. A review of the literature revealed that in certain areas of this country and Canada, cattle consuming spoiled sweet clover hay were subjected to a strange malady resulting in death caused by bleeding. This situation applied to this farmer's case.

It so happened that at this time Professor Link's laboratory was cooperating with the Department of Genetics at the University of Wisconsin on the problem of finding or developing a non-bitter strain of sweet clover hay. In their investigations it was found that the coumarin content of such hays increased on spoiling. Consequently, the chance meeting with this farmer added further interest to this particular phase of the problem and served as an inspiration for many years of research.

After several years it was proved that spoiled sweet clover hay did contain a coumarin compound which caused the blood to clot more slowly than normally. This factor was isolated from such hay and later synthesized in Professor Link's laboratories. It was trade-marked "Dicumarol."

Immediately, clinicians realizing the potential of "Dicumarol" in human therapy, proved that it was invaluable in preventing the formation of blood clots in man. It has proved to be valuable and effective in preventing coronary thrombosis or post-operative thrombi.

The rationale of the action of such an anticoagulant, perhaps is a little difficult to explain. Everything is not known as to how blood coagulates. It is accepted that blood clots in two phases: I. Prothrombin plus calcium plus thromboplastin yields thrombin, and, II. Fibrinogen plus thrombin yields fibrin (or the clot). An absence or deficiency of any one of these factors results in the failure of clot formation. It was proved that with such an anticoagulant, the prothrombin content of the blood was reduced. Whether it is a disturbance in the synthesis of prothrombin in the liver or a qualitative alteration in the prothrombin *per se* is questionable, but it is obvious that the prothrombin time is markedly increased upon the administration of "Dicumarol."

Warfarin Tests Continue

NOT satisfied with isolating and synthesizing the toxic principle of spoiled sweet clover hay, Link's group started in 1940 to seek a derivative of "Dicumarol" which might be speedier in action. In so doing, over 300 compounds were synthesized and evaluated physiologically. During the course of this work, Lester D. Scheel and Dorothy Wu of Dr. Link's staff, noted that one of these compounds (first synthesized the summer of 1942) was definitely

(*Turn to Page* 135)

Everyone in the trade is vitally interested in whether fertilizer raw material supplies will be ample for the coming season. Here is how the matter is regarded by an authority on the

Fertilizer Situation

by

John R. Taylor, Jr.*

Chief Agronomist, American Plant Food Council, Washington, D. C.

FERTILIZER supplies are definitely "tight" for the 1951-52 season, although indications are that record-breaking *total* quantities of fertilizers will be produced for the fourteenth consecutive year. The demand for fertilizers is at an all-time high and this demand is rapidly increasing, particularly in the Midwest. So, with farmers calling for more fertilizers, and a shortage of certain materials, particularly superphosphates and in some areas solid nitrogen, all farmers in all areas may not get exactly what they want this year.

Before discussing current supplies and future prospects, past records should be reviewed to gain perspective. Table 1 gives the consumption of plant food in the United States from 1900 to 1950-51.

In looking at Table 1, it is easy to note the fairly constant increase in consumption from 1900 to 1940 and then the remarkable increase in only 10 years from 1940 to 1951. During this short period, consumption of plant food made its greatest increase.

What has happened in the 13 midwestern states where much of this gain has been achieved? Table 2 gives the plant food consumption since 1934, and attention is again called to the remarkable increase during the period from 1941 to 1950.

Fertilizers for 1951-52

FOR the current season, for the nation as a whole, latest estimates by the U.S. Department of Agriculture indicate about 7 percent more nitrogen, 6 percent less available phosphate and at least 5 percent more potash than last year.

Nitrogen: Last year, farmers used about 1,285,000 tons of nitrogen, and the outlook for this year is an increase to around 1,375,000 tons. Most of the increased tonnage will be in the form of liquid nitrogen with very little increase in solid forms. Since sulfuric acid is necessary for the production of ammonium sulfate, the shortage of sulfur, and therefore sulfuric acid, is naturally affecting the production of this material. Also, there is a shortage of solid ammonium nitrate.

Phosphate: The supply of available phosphate is limited by the shortage of sulfur and sulfuric acid. With a world-wide shortage of sulfur, fertilizer manufacturers have been limited by orders from the defense agen-

Table 1
Plant Food Consumption in the United States

Period	Nitrogen Tons (N)	Available Phosphoric Acid Tons (P_2O_5)	Potash Tons (K_2O)	Total Tons (N,P_2O_5,K_2O)	Total Fertilizers Tons
1900	62,000	246,000	87,000	395,000	2,730,000
1910	146,000	499,000	211,000	856,000	5,547,000
1920	228,000	660,000	257,000	1,145,000	7,296,000
1930	377,000	793,000	354,000	1,524,000	8,425,000
1940	419,000	912,000	435,000	1,766,000	8,656,000
1950-51	1,285,000	2,235,000	1,445,000	4,965,000	19,000,000 est.
Increase Since 1940	866,000	1,323,000	1,010,000	3,199,000	
Estimated Supply 1951-52	1,375,000	2,100,000	1,515,000	4,990,000	

* Presented at the annual meeting sponsored by the Middle West Soil Improvement Committee, Chicago, Illinois, February 22, 1952.

Table 2

Plant Food Consumption in Ohio, Michigan, Indiana, Kentucky, Illinois, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, and Kansas

Period	Nitrogen Tons (N)	Available P_2O_5 Tons (P_2O_5)	Potash Tons (K_2O)	Total Tons (N,P_2O_5,K_2O)
1933-34	12,411	83,419	30,086	125,916
Calendar Year 1941	28,917	164,788	85,614	279,319
1949-50	174,877	661,197	389,004	1,225,078
Increase Since 1941	145,960	496,409	303,390	945,759

cies as to the amount of sulfur and sulfuric acid they can use in the manufacture of fertilizers. Thus, the production of normal (20%) and concentrated (45%) superphosphates, as well as some other materials, is definitely limited. Estimates are that we will have about 6 percent less available P_2O_5 than we had last year. There is no shortage of raw rock or manufacturing facilities, but solely a shortage of sulfur and sulfuric acid.

Potash: A record total of 1,445,000 tons of potash (K_2O) was available last year, and the outlook for this year is an increase of at least 5 percent. Production has started from another new mine in the Carlsbad area and existing companies have expanded their facilities.

Future Fertilizer Prospect

NO country in the world has ever witnessed such an expansion in fertilizer production as this country has in the last ten years. This expansion is continuing at a rapid rate, although limited by the shortage of certain building materials, principally steel, and raw materials such as sulfur and sulfuric acid.

In the nitrogen field, rapid expansion is now assured. On January 4, 1952, the Defense Production Administration announced a *domestic* nitrogen production goal of 2,930,000 tons of nitrogen annually by 1955, of which 2,185,000 tons is expected for agricultural use. Of this total amount, facilities for 2,430,000 tons are already built or authorized, according to DPA. The National Production Authority has announced that 155 new or expanded nitrogen plants are under construction or planned for immediate construction. Also, the Morgantown, West Virginia, Ordnance Plant is being reactivated, and production is scheduled to begin sometime this spring.

These new and expanded nitrogen plants are in various stages of construction, and since about two years are required to build a nitrogen plant, very little new production is expected before 1953. The full impact will not be felt before 1955 or later. At present, plant construction is hampered by the shortage of building materials.

In the phosphate field, expansion is taking place, but the bottleneck is the shortage of sulfur and sulfuric acid for the manufacture of superphosphates. Every effort is being made to break this bottleneck and some new sulfur mines are being put into operation, but our known economic sulfur resources are limited. New facilities are being installed to recover sulfur from various sources, including sour gas and fumes from industrial operations. However, contrasting prospective sulfur supplies with demands, it seems that agriculture will be faced with a sulfur shortage for many years.

New methods for the production of soluble phosphates which would not require, or which would reduce the need for sulfuric acid, are being investigated by fertilizer manufacturers. References have been made to direct acidulation of rock phosphate with nitric acid and by acidulation with various mixtures of acids such as nitric and sulfuric, phosphoric and sulfuric, and nitric and phosphoric. Thermal processes are also receiving attention. Some of these processes have been used in European countries for years, but so far have been uneconomical in this country. No doubt, satisfactory new methods will be developed and time will tell what the outcome will be in this field.

Rapid expansion is taking place in the domestic production of potash. Present companies are expanding their production facilities and two new companies are operating in the Carlsbad, New Mexico, area. Some production has started from one of the new mines, and the other is expected to come into production later this year. Future prospects for potash look good due to the remarkable development of our domestic potash industry.

In summary, the performance of the fertilizer industry in the past, and especially in the last decade, demonstrate an alert and progressive industry — an industry which will supply the fertilizers needed by American farmers.★★

Fertilizer industry is faced with a long-time sulfur shortage, but new methods for producing soluble phosphates being sought. Potash use increasing rapidly and new facilities for mining promise output will keep pace with all demands.

Study Group Reports on U.S.D.A. Programs for

Insect and Plant Disease Control

A six man study group, headed by W. A. Minor, assistant to the secretary of agriculture, has just filed its report on the insect and plant disease control programs of the U. S. Department of Agriculture. Appointed in September, 1951, by secretary of agriculture, Charles F. Brannan, this group was requested to study the control programs now being conducted by the department, inquiring into the need for continuing the various programs, and attempting to determine whether the programs are being carried out in the most economical and effective manner.

Without exception, the report recommends continuation of all present control programs. However, it offers a number of suggestions for changes in the way some of the programs might best be operated in the future. Of particular interest is the recommendation that "when pest control operations in one area are beneficial to farmers in another, consideration should be given to special assessments on the crops protected so as to spread the cost of control to growers who benefit."

It is pointed out that a problem exists in financing control programs where the benefits do not accrue to the persons on whose land the expense is incurred. Typical examples are cited in the stem rust and pink bollworm programs. In the case of stem rust, barberry eradication may be necessary on a farm where no small grain is produced. Similarly, in the case of pink bollworm, the program to limit spread of the pest is almost equally important to areas free from pink bollworm, but which may be susceptible to it, as it is to infested areas.

As a general principle, the study group has recommended that whenever pest control operations in one area benefit farmers in another, consideration should be given to special assessments on the crops protected so as to spread the cost of control to growers who benefit.

Another important feature of this report, is the suggestion that the present gypsy moth program be fundamentally changed. Instead of continuing with the present program of control, it is recommended that the department attempt complete eradication with a 5 year program. The cost of the intensified 5 year program is estimated at approximately 25 million dollars. If successful, it would eliminate gypsy moth completely, whereas if the present rate of expenditure is continued to simply contain this pest, the cost will be nearer 100 million dollars over a period of the next 50 years. If the program for a 5 year eradication plan is adopted, it is recommended that the cost should be met by about 15 million dollars from State and local sources, with the Federal Government contributing about 10 million dollars.

IN the general summary of its report, the study group offers the following comments:

(a) The need for continuing each of the control programs now in effect has been clearly shown. Some adjustments in the scope of present programs are recommended.

(b) Improved methods of control are needed in some programs, particularly in the pink bollworm program. These improvements will come about as a result of research efforts which are not adequate at the present time. Additional research funds are badly needed.

(c) Non-Federal cooperation and contributions have been increasing in recent years, and as a result considerable progress has been made. Additional progress can be made in some programs.

(d) The enforcement of adequate State laws relating to insects and plant diseases is so important that it should be a prerequisite to the granting of Federal assistance where ever this is practicable. However, an exception must be made if failure of one State to act would jeopardize control programs of cooperating States.

Amplifying this set of recommendations, the following conclusions are also discussed in detail.

1. Over-all efforts to eradicate or suppress insects and plant diseases should be continued and intensified.

2. Costs of control measures should be distributed among Federal, State, and local agencies and individual operators, with the Federal Government providing over-all direction and coordination of programs of regional or national concern.

3. Each program should be reappraised periodically to determine whether eradication is possible and if the most effective means of control are being utilized.

4. Research should be supported by increased Federal funds as a means of increasing effectiveness of control and reducing costs. State and private support for research should also be encouraged.

5. Surveys of insect and plant disease infestations should be unified and intensified by the Federal Government in cooperaton wtih State and local authorities.

6. Cooperative State and Federal domestic quarantine programs should be continued, with costs to be met as far as possible by State appropriations or fees on products inspected.

7. Educational efforts related to insects and plant diseases should be expanded by the Cooperative Agricultural Extension Services.

8. Control and eradication of insects and plant diseases should be carried out by individual operators wherever feasible, with the Government assuming major responsibility for research, surveys, education and coordination.

9. The creation of pest control districts should be encouraged when area-wide treatment will contribute to greater efficiency.

10. When pest control operations in one area are beneficial to farmers in another, consideration should be given to special assessments on the crops pro-

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Compound A42—Arsenomethane As-1, 2 Disulfide, a new

Organic Arsenical Insecticide

ORGANIC arsenical insecticides, until recently, have not been used for large scale commercial insect control. Frear's Catalogue of Insecticides and Fungicides (1) contains 10,000 biologically tested materials, but lists only some 70 arsenicals, including the inorganic compounds. Lack of complete information on almost half of these probably gave impetus to the work of Y. F. Hsing (2), whose tests on the confused flour beetle with certain free and substituted phenyl-arsenic and naphthylarsenic acids revealed that the toxicity of 2-amino-1-naphthalene arsenic acid is second to that of DDT on the basis of time required to cause 50 per cent mortality at a 0.5 per cent dilution. The U. S. Chemical Warfare Service (3) showed that organic arsenicals gave promise of producing insecticides equal to or better than the old-time inorganics. The improved toxicity over the inorganics is due to the combination of toxic arsenic with organic radicals, each of which aquires potency from the organic-arsenic linkage. The key to such values is found in examining the organic arsenical medicinals, well known to have bactericidal properties. The success of the salvarsan series was largely responsible for the investigation of related organic arseno compounds resulting in the discovery of Arsenomethane As-1, 2 Disulfide (Compound A42)* by Dr. Roland M. Kary (4), Central Research Laboratory of American Smelting & Refining Company.

*Patent application pending.

Properties of the new compound are as follows:

Formula: $C_2H_6As_2S_2$

Structure: $H_3C-\underset{\underset{S}{\|}}{As}=\underset{\underset{S}{\|}}{As}-CH_3$

Molecular Weight: 244.01

Physical Properties:

1. Melting point: 93°C
2. Boiling point:
   250°-260°C (decomposes)
3. Vapor pressure:
   0.0006 mm Hg at 27°C
   0.0050 mm Hg at 50°C
   0.0200 mm Hg at 80°C
4. Volatility:
   0.14% under atmospheric conditions during one week.
5. Specific gravity:
   $\frac{1.14 \quad 25.3°C}{25.3°C}$
6. Solubility (organic solvents):
   a. carbon disulfide: very soluble
   b. naphtha, chloroform, ethyl ester: somewhat soluble
   c. kerosene, ethyl alcohol, methyl alcohol, methylated naphthalene: slightly soluble
   d. xylene, petroleum ether,

TABLE I
Toxicity of Arsenomethane As-1, 2-Disulfide Tested on Various Insects

Insect	Approx. LD-50	Test Medium or Host Plant	Injury to Host Plant
Confused Flour Beetle	0.005%	Wheat Flour	None
Termite	0.05%	Soil-Sawdust	None
Granary Weevil	0.10%	Whole Grain	None
Carpet Beetle	1.0% after 30 days	Soy-Wheat Flour	None
Grasshopper	0.5 lb./100 gals. (90% kill)	Grass	None
	4.0% Poison Bran	Grass	None
	5.0 Dust in Ca $(OH)_2$	Grass	Slightly burned
Japanese Bettle	5.0% Dust	Smartweed	Laboratory Test
Mexican Bean Beetle (3rd Instar Larvae)	2.0-4.0% Dust	Bean Plants	Severe (effect of correctives not tested)
Colorado Potato Beetle (Larvae)	5.0% Dust	Potato Plants	Severe (effect of correctives not tested)

by
Theodore Riedeburg
Theodore Riedeburg Associates
New York, N. Y.

toluene, benzene: insoluble

7. Water soluble arsenic: 4.8% of total Arsenic (A.O.A.C. Specification) 1 gram compound in 500 cc distilled water 24 hours.

Research is now in progress on toxicity to warm blooded animals. Until complete results are available, workers are advised to use the same precautions in handling Compound A42 as are used with DDT and BHC. Those who apply dusts or sprays in the field, or who work in formulating plants, should wear goggles and organic vapor-type respirators.

During 1951, under a fellowship at Rutgers University, sponsored by the American Smelting & Refining Company, and in cooperation with the Department of Entomology, Pasquale L. Pontoriero (4) investigated the insecticidal activity of Compound A42 and studied its phytotoxicity.

The new arsenical was tested in the laboratory using confused flour beetles, termite, granary weevils and carpet beetles. Test media resembling these insects' natural environment were mixed with the toxicant at various concentrations. Insects and media were placed in closed containers and, after a definite length of time, notations on mortality and activity were made. Tests on grasshoppers, Japanese beetles, Mexican bean beetles and Colorado potato beetles were made on growing plants, using sprays and dusts of Compound A42 at various concentrations. The per cent mortality was recorded after a few days of feeding. Results of these tests are shown in Table I.

Tests were run to determine the LD-50 of Compound A42 as compared with various other insecticides now in common use. Table II shows that the toxicity of Compound A42 against the confused flour beetle and the German roach is greater than that of most standard insecticides. Both Tables I and II show that relatively low concentrations of Compound A42 are required to obtain an approximate LD-50 of most of the insects tested.

Observations of the degree of phytotoxicity of Compound A42 were made on eight different field crops, under New Jersey field conditions. Summarized in Table III are the maximum concentrations which gave no injury, with or without calcium hydroxide as the corrective. Table IV shows the minimum concentrations which will give some in-

(*Continued on Page 131*)

TABLE II
LD-50 of Arsenomethane As-1, 2-Disulfide As Compared with Standard Insecticides.

Insecticides	Insects			
	Confused Flour Beetle	Mexican Bean Beetle	German Roach	Colorado Potato Beetle
Calcium Arsenate	2.0%	5.0%	2.5%	4.0%
Rotenone	0.25%	0.15%	0.5%	0.25%
DDT	0.015%	—	2.0%	2.5%
Parathion	0.0005%	—	—	—
Arsenomethane As-1,2-Disulfide				
Crude	0.015%	2.0-4.0%	0.25%	1.0%
same, purified	0.005%	—	—	—

TABLE III
Phytotoxicity of Arsenomethane As-1, 2-Disulfide Tested on Various Agricultural Crops Maximum Concentration Showing No Plant Injury

	Lbs. /100 gals. Spray			Per Cent Dust	
CROP	Conc.	$Ca(OH)_2$ Corrective	No. of Applic.	Concentration	No. of Applic.
Potato	0.50	—	1	1.0 in Attaclay	1
Tomato	0.25	—	1	1.0 in Attaclay	2
	—	—	—	5.0 in Attaclay	1
Pepper	0.25	—	2	10.0 in $Ca(OH)_2$	1
	—	—	—	—	—
Cucumber	0.25	—	1	—	—
Corn	0.25	1.0	1	—	—
	—	—	—	—	—
Bean	—	—	—	0.5 in Attaclay	1
Peach	0.01	—	1	—	—
	0.10	0.2	1	3.0 in $Ca(OH)_2$	1
	0.025*	—	1	—	—
Pear	0.25	1.0	1	1.0 in Attaclay	3
	0.25*	—	1	1.0 in $Ca(OH)_2$	1
Apple	0.075	—	1	0.5 in Attaclay	2
	0.25*	—	1	—	—

* Decreased solubility in water obtained from a water-washing process.

The Fundamentals Behind

Fungicide Research

PHENOMENAL progress has been made in developing new fungicides for use in preventing plant diseases, fabric deterioration, wood decay, and leather mildewing during the past seventeen years. This will be remembered as the era in which we shook off the lethargy of satisfaction and began to put our knowledge of chemistry to work. Such remarkable materials as the dithiocarbamates, quinones, imidazolines (glyoxalidine), phenyl mercury compounds, quaternary ammonium detergents, thiuram disulfides, bisphenyl alkanes, chlorophenates, naphthenates, nitrosopyrazoles, quinolines, perchloromethyl derivatives, and chromates came from the laboratories and took their place alongside compounds of sulfur, copper, mercury and formaldehyde in the fungicide arsenal.

These new materials are superior to older fungicides for many uses. Furthermore, we are controlling more plant diseases today than would have been considered possible a decade ago because many of the new materials are effective against fungi that had been considered as resistant to chemical toxicants. Many of the newer materials also are safer for use on plants and are less disagreeable and hazardous to spray operators and consumers of food products. New markets for fungicides have been created and many people have gained faith in their use. The new chemicals are currently selling at the rate of about $8,000,000 per annum.

There is every reason to believe that this progress will continue. Probably no more than 100,000 different chemicals have been tested for one or more uses; so many classes of compounds will provide virgin hunting grounds. The scientists have perfected effective testing procedures and gained valuable experience so their efforts should be more effective, and management is more willing to support them than ever before.

More important than these considerations is the need for even better chemicals in agriculture and industry. There are at least 1.6 billion dollars of agricultural produce and another billion of finished products being destroyed each year in spite of the best fungus control measures now possible. If past experience is any indicator, the control of one billion of this damage would bring the benefactors about fifty million dollars of business per annum (20).

Some of these diseases probably will not be controlled economically. Other measures such as resistant varieties will solve some of the problems, but a heavy burden of responsibility rests on the fungicide experts. Furthermore, we can never be certain when a new race of stem rust or similar parasites now controlled by resistant varieties may make unprecedented demands on the industry for new materials in tremendous volume.

The difficulties in this search for new materials should not be minimized. The requirements in fungicidal performance are growing more exacting with every new discovery, and competition is keen. Research now must embrace, in more or less ascending order, studies on: fungicidal effectiveness, persistence in all sorts of weather, safety for crops and compatibility with other pesticides, freedom from adverse side effects on soil and beneficial organisms, quality of agricultural produce, dermatological and toxicological effects on spray operators, and hazards from residues in food products.

The chances of failure multiply geometrically as these studies are pyramided one upon the other. After searching through all available information and comparing notes with others having considerable industrial experience, Wellman (21) concluded that no more than one compound in 2,000 succeeded as a pesticide. The cost of synthesizing and screening a new material was estimated to average $350. If we assume half of this cost should be charged to fungicide studies and only one compound in 30 survives the initial screening tests, each candidate chemical will repre-

* Based on a talk delivered before the 13th Annual New York State Insecticide-Fungicide Conference of Cornell University at Ithaca, New York, on November 18, 1961.

By George L. McNew*

Boyce Thompson Institute for Plant Research
Yonkers, N. Y.

sent an initial investment of $5,250. Further laboratory, greenhouse and field tests will bring the cost to over $7,000 and no more than 3 per cent of the candidates will be retained. Thus, a fungicide might represent an initial investment of over $200,000 when it is turned over to the sales department for commercial development—and it will have no more than a 50 per cent chance of success at that point. The only justification for such expenditures is the potential markets awaiting successful chemicals.

It is obvious that the chemists and plant pathologists will have to find methods of improving their efficiency even more than at present. They are going to have to call their scientific shots much better than in the past, so they will not build up such a tremendous overhead in failures when they synthesize and test chemicals empirically. When they find a good candidate, they will have to exercise every ingenuity in perfecting its performance so it will be attractive economically to both the user and the manufacturer.

This ideal attack is still in the blueprint stage. There is not enough fundamental information available to guide applied research unerringly to fungicides and to make them perform perfectly. Such information can and will be obtained however, so it is not out of order to examine what we have discovered and see how it has been used in developing the new fungicides now on the market. The development of a new fungicide naturally breaks down into locating a new fungitoxic nucleus, modifying its properties by proper substitution, improving its spore penetrating ability and improving its efficiency in protecting plant surfaces by proper formulation.

The Search for Active Nuclei

THE usefulness of most inorganic fungicides was discovered by fortuitous observation. Bordeaux mixture was discovered in the vineyards of France where a mixture of bluestone and lime had been used to deter the pilfering of grapes along the roadways. Lime-sulfur gained popularity as an apple fungicide after it had been applied extensively to control scale insects. Such discoveries of ready-to-use materials are the exception and there is little likelihood of further progress of this sort. In the modern search for fungicides, it is necessary to locate active nuclei among the organic compounds and then modify them by proper substitution to obtain maximum effectiveness.

Present techniques consist of testing representative chemicals from the various classes until a compound with reasonable activity is detected. Attention is then concentrated on the

Figure 1

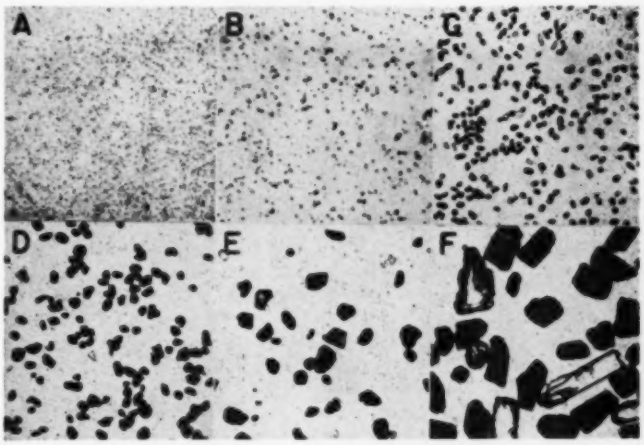

Figure 1. Representative particles isolated from a sample of pure dichloronaphthoquinone ground in a Raymond pulverizer. These particles range in size from 0.5 to 1.0 μ radius (A), 1.0 to 3.0 μ (B), 3 to 5 μ (C), 5 to 10 μ (D), 10 to 20 μ (E), and >20 μ (F). The ideal particle size for this fungicide is represented by sample C. The particles in A and B are so small that many of them are required to destroy a fungous spore. When first deposited, they are efficient per unit weight of material applied but so much surface is exposed to sunlight and air that they lose effectiveness very rapidly. Particles D, E, and F are so large that excessive amounts must be applied to assure at least one particle of material in the vicinity of each spore that may land on the leaf surface. They are, therefore, inefficient and also expose too much surface per unit of disease control.

various analogs of this compound and its substitution products. This empirical procedure has been adequate for detecting such active groups as the dithiocarbamates, quinones, chlorophenates, benzothiazoles, sulfonamides, phthalimidines, thiuram disulfides, pyrazoles, imidazolines, perchloromethyl sulfide compounds, and organic mercury compounds. It is not infallible, since active groups may be overlooked by choice of an inactive member for testing. The pyrazole nucleus, for example, was considered of little promise by Horsfall (9) who had tested antipyrine, but when properly substituted in the 1- and 4- positions (14), was found to contain some of the most potent organic fungicides known.

Empirical testing is like probing in the dark for a light switch. There are hundreds of misses for every successful contact. This is an expensive procedure, so the question may be fairly asked as to whether there are any short cuts. There are no infallible ones, but a few guideposts have begun to materialize. Those materials that are either chemically reactive, have strong oxidation potentials, can chelate with metal ions, are strongly surface active, or have chemical configurations analogous to those of essential metabolites, may be expected to be fungitoxic—provided they can penetrate the spore wall. Each of these items might be clarified by a brief discussion.

All of the better fungicides are chemically active. Inert substances do not kill fungi insofar as we know. The copper ion is an excellent fungitoxicant but combines with organic radicles so firmly that most organic copper compounds are relatively inactive. Most of the organic zinc compounds are superior to their copper analogs even though the zinc ion is definitely inferior to copper. If the reactive groupings or organic molecules are blocked, fungitoxicity disappears. Powerful fungitoxicants of the quinone and dimethyl dithiocarbamate classes can be reacted to give substituted quinones, but the reaction product is much less potent than either reactant.

Strong oxidants are often, but not always, fungitoxic. Standard accelerants for vulcanizing rubber such as tetramethyl thiuramdisulfide, diphenyl guanidine, and zinc dimethyl dithiocarbamate are good fungicides. Chloranil was selected by W. P. ter Horst for fungicide evaluation because of its oxidized state. Halogenation of some fungicides to increase their oxidation potentials increases their biological activity. Good correlation between oxidation potential of several quinone compounds and bacteriostasis for gram positive bacteria has been reported by Page and Robinson (16). The same rule, however, does not hold for gram negative bacteria or fungi. The reduced forms of many fungitoxic chemicals also are biologically active but usually are inferior to their oxidized analogs.

The reason for fungitoxicity of chemicals with strongly reactive nuclei or strong oxidative tendencies is not fully understood. It is assumed that they may combine readily with free sulfhydryl or other reactive groupings in proteins, enzymes, or other essential chemicals of the cell.

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Figure 2

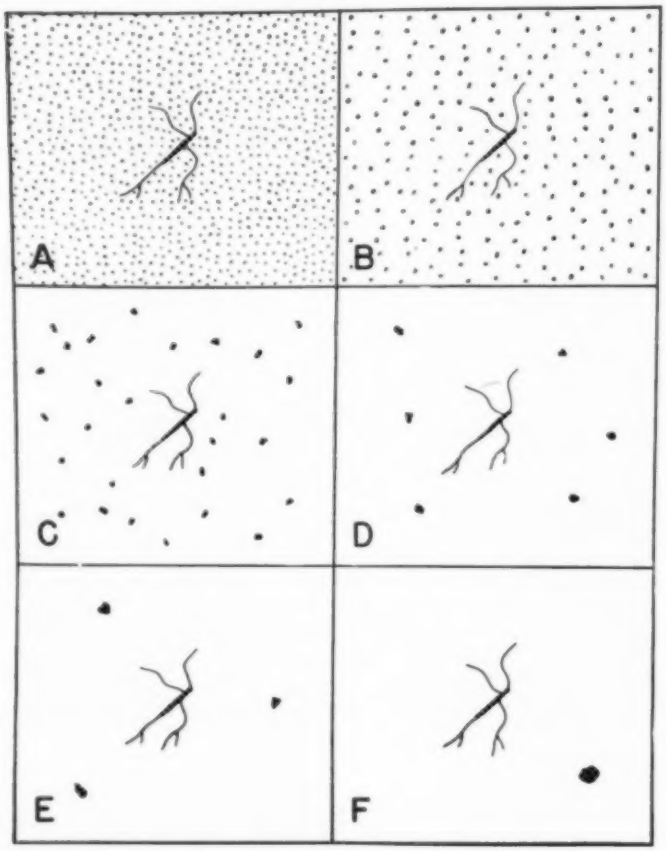

Figure 2. Typical deposits of dichloronaphthoquinone (Phygon) required to provide 95% control of Alternaria blight on tomatoes when particles average 0.81 (A), 1.48 (B), 3.57 (C), 8.36 (F), 13.8 (E), and 24.5 (F) microns in radius. Each block represents 0.1 of a square centimeter of leaf area with spores and particles drawn to scale.

PAPERS covering various phases of insecticides and residues were all set for presentation at the 121st National Meeting of the American Chemical Society at Milwaukee, as we went to press. The meeting, March 30 to April 3, is the second part of the national gathering, with the other sections meeting in Buffalo, N. Y., March 23-27.

Dr. H. L. Haller, assistant chief, Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, Washington, was to be chairman of the pesticides subdivision meeting April 1, with L. G. Cox, secretary. Papers scheduled for delivery at this session included "Dieldrin Residues in Citrus Fruits" by F. A. Gunther, W. H. Ewart and J. H. Barkley, Univ. of California, Riverside. They reported results of over 500 organic chloride determinations of the persistence and penetration of dieldrin residues as well as studies of the ease with which dieldrin residues may be removed. Both laboratory and commercially - processed juices prepared from treated fruits have been examined for dieldrin content.

W. T. Sumerford, Western Toxicology Laboratory, U. S. Public Health Service, Wenatchee, Wash., discussed synergism of the halogenated hydrocarbon insecticides. The subject was approached from three angles: the chemical and biological activity of the synergizing agent, the possible mechanism of activity of the synergist and the practical application of the insecticide-synergist combinations toward warm-blooded animals.

Residues Studied

A SYMPOSIUM on residues was to be held on Wednesday morning, with Avery S. Hoyt, chief of the Bureau of Entomology and Plant Quarantine, in charge. In his opening remarks, Mr. Hoyt summarized the residue problem, expressing hope that better understanding of the matter will be helpful in its solution. These problems must be solved if the new insecticides are to be used effectively and safely, he declared.

Dr. Fred C. Bishopp, assistant chief, B.E.P.Q., was to speak on the residue problem related to pesticides in agriculture. His paper covered the necessity of using pesticides to produce food, feed and fiber, and the various problems to be met in controlling insects of different species and under diverse conditions. Dr. Bishopp also outlined the procedures now in use to control insects and at the same time to make insect control safe.

The pharmacological viewpoint was discussed by Dr. A. J. Lehman, Food and Drug Administration, Washington. He summarized the response of animals to chronic ingestion of about 50 commonly used pesticides, and correlated the dietary level fed, with the degree of intoxication resulting.

General medical aspects of the residue problem were to be discussed by Dr. Bernard E. Conley, Committee on Pesticides of the American Medical Association. On the assumption that many pesticides in commercial use can constitute a health hazard, Dr. Conley discussed the nature of the hazard, the degree to which it existed in the past as compared to the present and the factors which predispose to its continuing existence. Comparisons were drawn between the laboratory developmental data and clinical findings in cases of poisoning.

Herbert E. Longenecker, U. of Pittsburgh and member of the Food Protection Committee of the National Research Council reviewed the progress of the committee in carrying out its functions. He enumerated the objectives of the committee as follows:

1. Assemble scientific information on both incidental and intentional chemical additives which are used or proposed for use in or on foods to summarize and evaluate this information and make its conclusions available in usable form to those interested.

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Corn
Cotton
Cucumbers
Eggplant
Grapes
Hops
Kale
Melons
Mustard
Oats
Okra
Olives
Onions
Ornamentals
Peaches
Peanuts
Pears
Peas
Peppers
Pineapples
Plums
Potatoes
Prunes
Spinach
Squash
Strawberries
Sugar beets
Tobacco
Tomatoes
Turnips
Vetch
Walnuts
Wheat

2. Advise and assist industry and federal and state governmental agencies in the integration of research on the utilization of chemicals in food production, processing, and preservation, and to promote additional research, by existing agencies, which in the opinion of the committee appears desirable in the public interest.

3. Develop guiding principles and standardized procedures essential to safeguard food.

4. Encourage and aid in the distribution of accurate scientific information to the general public.

Present Safeguards Reviewed

PESTICIDE Residues and Legislative Safeguards were discussed by Joseph A. Noone, NAC Association, Washington, D. C. He enumerated the legislative safeguards to protect the public health against possible injury from residues of pesticides, stating that such protection is contained in the provisions of the Federal Insecticide, Fungicide and Rodenticide Act; the Federal Food Drug and Cosmetic Act, and state acts.

Provisions for registration with the U. S. Department of Agriculture before introduction into interstate commerce are contained in the Insecticide Act, and consideration is given to possible residue hazards as well as efficacy for the purpose intended. Control is thus exercised over the pesticide and any associated residue hazard both prior to and during marketing.

Also mentioned by Mr. Noone was the fact that the Food, Drug and Cosmetic Act authorizes the Federal Security Administrator to limit, by regulation, the quantity of pesticidal residues and other poisonous and deleterious substances which may remain on food, and directs him to limit such substances to such extent as he determines to be necessary to protect the public health. Other provisions specify that a food is adulterated if it contains any quantity of these substances in excess of that established by the regulation.

Still another provision specifies that a food shall deemed to be adulterated if it contains any quantity of such a substance as may render it injurious to health, regardless of whether a residue tolerance has been established for that substance. Mr. Noone concluded that exercise of the authority contained in these acts offers adequate protection to the public health from dangers of pesticidal residues.

Necessity for Residues

THAT a certain amount of residue is necessary, was reiterated in a number of papers presented at the Wednesday afternoon session under the leadership of Dr. Charles E. Palm, Cornell University, Ithaca, N. Y. In his introductory remarks, Dr. Palm declared that pest control must be considered as an integral part in the planning and operation of modern agriculture. Insects, diseases, rodents and other forms of destructive life are a constant menace, he said.

The chemical industry is making an outstanding contribution to the health and welfare of the world through its development and production of pesticidal materials, he said. The scientists of government and industry are cooperating in providing a program of safe and efficient use of pesticides in crop production and protection. The data presented by over 240 witnesses from all parts of the nation comprise the most complete testimony ever assembled on the subject of residues. All concerned with pest control are working toward a common objective of receiving the maximum benefits in production, with safety to both the consumer and the producer, Dr. Palm concluded.

"Fungicides on Fruit Crops" were discussed by Dr. George L. McNew, Boyce Thompson Institute, Yonkers, N. Y., with special emphasis on the necessity for residues in this connection. He said that some of the major fruit-growing areas of the U.S. would cease to produce apples, peaches, cherries, grapes, citrus, etc. if fungicides were not used. He said that diseases in permanent orchards and plantations have an ideal opportunity to become established because rotation of crops is impossible; because varieties are selected for flavor and appearance rather than for disease resistance; because products are harvested and stored in a fresh condition for long periods and because relatively minor blemishes render products unsalable. Although resistant varieties can be developed, several decades are required to perfect them and market requirements favor established varieties. Diseases may be partially alleviated but never controlled by suitable orchard management such as pruning and fertilizing.

Spraying schedules may be adjusted to avoid excessive residues. Illustrations of how spray programs are developed around predominant diseases such as scab of apples (loss 5.6%), brown rot of peaches (loss 4.8%), and leaf spot of cherry (loss exceeding 5%), and modified to prevent dominant minor diseases are typical. Use of dormant sprays, ground applications, and sanitary practices that reduce the inoculum potential in orchards also reduces the amount of spray deposit required for disease control. Proper formulation of sprays to avoid deposit building and permit uniform coverage by the smallest possible sized particles lessens the possibilities of excessive residues. Since almost all sprays must be applied before infection to serve as a protective covering for all susceptible surfaces, the number of particles deposited per unit area and their persistence, the principles of which are discussed from illustrative data obtained on dichloronaphthoquinone, becomes a major consideration in suppressing residues.

The necessity of using insecticides on fruit crops was pointed out by B. A. Porter, B.E.P.Q., Washington, D. C. His paper emphasized three points: the necessity for controlling insects on fruit trees; the necessity for using insecticides for this purpose and the unavoidability of some insecticidal residue in the process. A lack of chemical control measures would mean the destruction of the apple crop in most localities, since mechanical means to control worms have not given practical control. Thus, growers have found it necessary to use insecticides despite the cost of as much as $100 per acre.

Because the fruit itself must

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Herbicides, Insecticides, Fungicides and Application Methods Discussed at

Alabama Short Course

A HEAVY snow fall and inclement weather cut attendance to 85 at the three day plant pest control conference held on the Alabama Polytechnic Institute Campus at Auburn, Alabama, February 25-27. Present were state plant inspectors, aerial applicators, pesticide manufacturers and distributors, flying farmers, research and extension workers, and representatives of the state department of aeronautics and agriculture. Also in attendance were 32 representatives of 19 manufacturers, plus numerous mixers and distributors of pesticides. Most of the conferees were from Alabama, but also represented were Georgia, Mississippi, Illinois, Tennessee, Pennsylvania, Texas, Florida and North and South Carolina.

The conference was held by A.P.I. Agricultural Experiment Station. Participating agencies were the Alabama State Department of Aeronautics, Division of Plant Industry of the State Department of Agriculture and Industry, Alabama Flying Farmers Association; and pesticide manufacturers and distributors.

The first day's program was the 6th annual workshop for state plant inspectors, while the last two days was the third annual short course for aerial applicators, and pesticide manufacturers and distributors.

Members of the conference were welcomed to the campus of A.P.I. by Dr. E. V. Smith, Dean and Director.

George R. Williamson, General Manager of Agricultural Sulphur and Chemical Company, Montgomery, Ala., told the conference that the supply of agricultural chemicals during 1952 would be sufficient except for sulphur, copper, lead and certain grain fumigants. He warned, however, that consumers and distributors would have to cooperate with producers by systematic buying now so as not to tax unduly manufacturer's storage, shipping and production facilities by waiting until a few weeks before and during actual using season before making their needs known. By failing to buy now, serious shortages could develop at the actual consumption season.

Dr. George C. Decker, entomologist and head of Economic Entomology section of Illinois State Natural History Survey, Urbana, Illinois, reviewed spray residue problems. He stated that while all insecticides are toxic, carlessness and ignorance on the part of persons using them are the real cause of most resulting fatalities. Legislation resulting from present F.D.A. hearings would probably not be ready to cover the 1952 season in his opinion. In all likelihood, the F.D.A. will set preliminary tolerances, he predicted, and then may permit a 90 day observance period, after which all data would be reviewed in the light of actual results obtained. Following this, official tolerances will probably be established.

Hoyt Nation of Dow Chemical Co., Midland, Mich., who reported on pre-emergence chemical control on cotton, told of the new interest in the use of chemical herbicides in the south due to the present scarcity of labor.

John Paul Jones, aircraft flight test engineer, Civil Aeronautics Administration, Fort Worth, Texas, reported on the new AGI plane designed and constructed at Texas A & M for use in agricultural spraying and dusting. Mr. Jones, who had flown the plane in from Texas, gave a full description of its features, and an actual flight demonstration at the local airfield.

Mr. William Dickison of the National Sprayer and Duster Association reported on new equipment which permits applying chemicals in

concentrated form, thus opening an expanding field of service for custom sprayers. First applied to the spraying of the new weedicides, the low gallonage application method has been extended to the field of spraying of insecticides and recent tests with the newer fungicides at low rates look very promising. Many features of the tractor-mounted weed sprayer introduced in recent years have been improved and special models have been adapted specifically for use on row crops such as cotton and on other field crops.

A complete evaluation of insecticides and fungicides for farm use was covered by members of the API entomology staff under the direction of L. A. Ruffin, moderator and coordinator of this phase of the program. Latest research data were given on this subject by Dr. F. S. Arant, entomologist, who reported on cotton insects in Alabama; by Dr. W. G. Eden, associate entomologist, on corn and tomato insects in Alabama; on insects affecting potatoes and peaches in Ala. by Dr. R. L. Self; on peanut insects in Ala. by Dr. R. S. Davidson, plant pathologist; on livestock inspection by Dr. G. H. Blake, Jr., Asst. entomologist; and on household pests by Dr. F. E. Guyton, professor of entomology.

Presiding at the various sessions were Gus Ashcraft, Ashcraft-Wilkinson Company, Atlanta; Asa Rountree, Director State Department of Aeronautics; Robert G. Pitts, Head Professor, Aeronautical Engineering, and Director, Auburn School of Aviation; and Homer Kindig, Greenwood Products Co., Graceville, Florida.

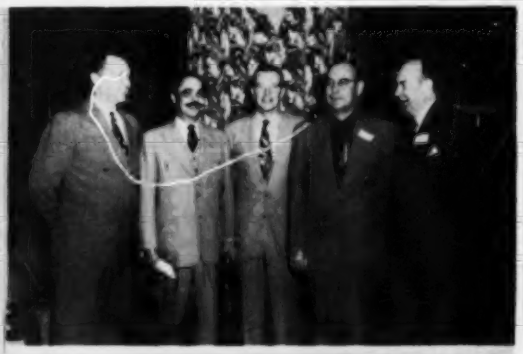
(*Turn to Page 159*)

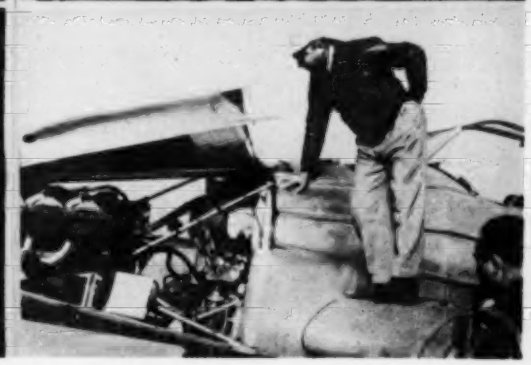
Upper left: Representatives of agencies participating in Conference. Left to right they are: James McAlister, Mgr., Huntsville Air Service, Huntsville, representing the Alabama Flying Farmers Association; Dr. E. V. Smith, Director, A. P. I. Experiment Station, sponsors of the conference; George R. Williamson, Agricultural Sulphur and Chemical, representing pesticide manufacturers and distributors; and Asa Rountree, Director, Alabama State Department of Aeronautics. B. P. Livingston, Chief, Division of Plant Industry, State Department of Agriculture and Industry, was not present for picture.

Upper right: Preside at Pest Control Conference. Shown with Dr. F. S. Arant, (center) head, Zoology-Entomology Department, A. P. I. and general program chairman of the conference, are the men who presided. (left to right) Robert G. Pitts, head professor Aeronautical Engineering, and Director, Auburn School of Aviation; Gus Ashcraft, Ashcraft-Wilkinson Co., Atlanta; Dr. Arant; Homer Kindig, Greenwood Products Co., Graceville, Fla.; and Asa Rountree, Director, State Department of Aeronautics, Montgomery, Ala.

Lower left: W. T. Piper (right), President of Piper Aircraft Corp., Lock Haven, Pa., flew down for the Pest Control Conference. He is shown with aviation enthusiasts Hugh W. Wheelless, (center), Dothan Aviation Co., Dothan, Alabama; and Robert G. Pitts, Director, Auburn School of Aviation.

Lower right: Demonstrates Experimental Agricultural Airplane. John Paul Jones, Aircraft Flight Test Engineer, CAA, Fort Worth, Texas, discusses the performance and safety features of CAA's agricultural airplane in applying pesticides. Mr. Jones demonstrated the plane at the Alabama Conference.





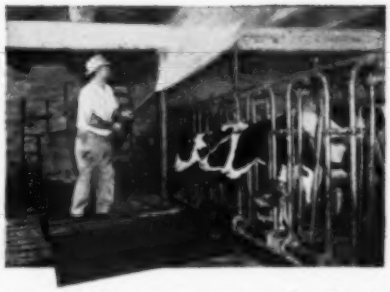
All along the "Milk Route"

Pyrenone* protects against insects

*Reg. U. S. Pat. Office.

U.S.I.

Of the many insecticides available to the American dairyman, Pyrenone is one of the very limited group recommended for use on the cow and is the only one effective on tabanids (horseflies).



Surface treatments with Pyrenone sprays are generally used on places that are most favorable to flies for the quick knockdown and kill that Pyrenone gives, without toxic hazards to animals or operators.

The freedom from toxic hazards, plus the quick knockdown that Pyrenone gives, make it a preferred insecticide for use in premises where milk is handled and cooled.

Wherever milk products are processed, bottled, packaged or stored, Pyrenone gives effective control of a wide range of insects — yet without hazards to either employees or products.

Fly and insect annoyances in the home are also controlled with Pyrenone-based insecticides with similar effectiveness, economy, quick results and safety-factor advantages.

FROM FARM TO FAMILY, Pyrenone-type insecticides are relied upon for effective and economical pest control — free from hazards. All kinds of products made with Pyrenone meet the specialized needs of the places where milk or food is produced and handled.

Oil-type sprays . . . aerosols . . . emulsifiable sprays and insecticide dusts and powders are made with Pyrenone. It is rapidly gaining preference in the dairy industry because properly-formulated and applied Pyrenone insecticides present no toxic hazards to farmers, spray operators, animals or to milk or milk products.

Pyrenone is effective on *all* species of flies and a wide range of other insect pests such as roaches, silverfish, weevils, etc. Keeping these pests away from the food supply lines is a never-ending job of careful sanitation, and Pyrenone helps sanitation with a quick knock-down and kill of obnoxious and destructive insects.

Formulate your insecticides using Pyrenone. Put Pyrenone on your label (write for full particulars on use of this trade mark). Through national advertising, people all along the "milk route" from farm to family know that Pyrenone means an exceptional combination of the factors of effectiveness, economy and freedom from hazards.

U.S.I

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Division of National Distillers Products Corporation, **60 East 42nd Street, New York 17, New York**

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Branches in principal cities.

Have fertilizer sales reached their peak in the U. S.? Does human disease follow the extensive use of commercial fertilizers? Here are some vital statistics on

FERTILIZER TRENDS

Malcolm H. McVickar National Fertilizer Association, Washington, D. C.

ACCORDING to the most reliable figures available, during the calendar year 1951, an estimated 19½ million tons of fertilizer were applied on farms in the United States. This is more than twice the quantity used a decade ago. Despite this fact, however, only about 60% of the farmers in America use commercial plant food today. That in itself is indicative of the scope of future development. This article is to review what's happened in the past, with a few predictions for the future.

The year 1950 was widely publicized as being the Centennial of the fertilizer industry which was founded in Baltimore, Md., in 1850. Thus, at the mid-century mark, it seemed a good time to make a survey to determine where and how these millions of tons of fertilizer were being used.

Included here are many data summarized by the National Fertilizer Association, comparing, in many cases, figures of 1950 against those of 1938 and 1927. These latter years were selected because more information is available on these particular periods.

Table 1 indicates the tons of plant food used in the United States in various years, beginning in 1900.

Table 2 shows the regional use of plant food in 1927, 1938 and 1950. Of particular interest is the great increase in percentage of use in the Pacific states which climbed from 1.84% of the total in 1927, to

TABLE 1

Tons of Plant Nutrients Used in USA

1900	62,000	246,000	87,000	395,000
1925	279,000	680,000	283,000	1,242,000
1949-50	1,005,000	1,951,000	1,105,000	4,061,000
1950-51	*1,285,000	*2,235,000	*1,445,000	*4,965,000

*Estimated.

TABLE 2

Where is the Fertilizer Used?

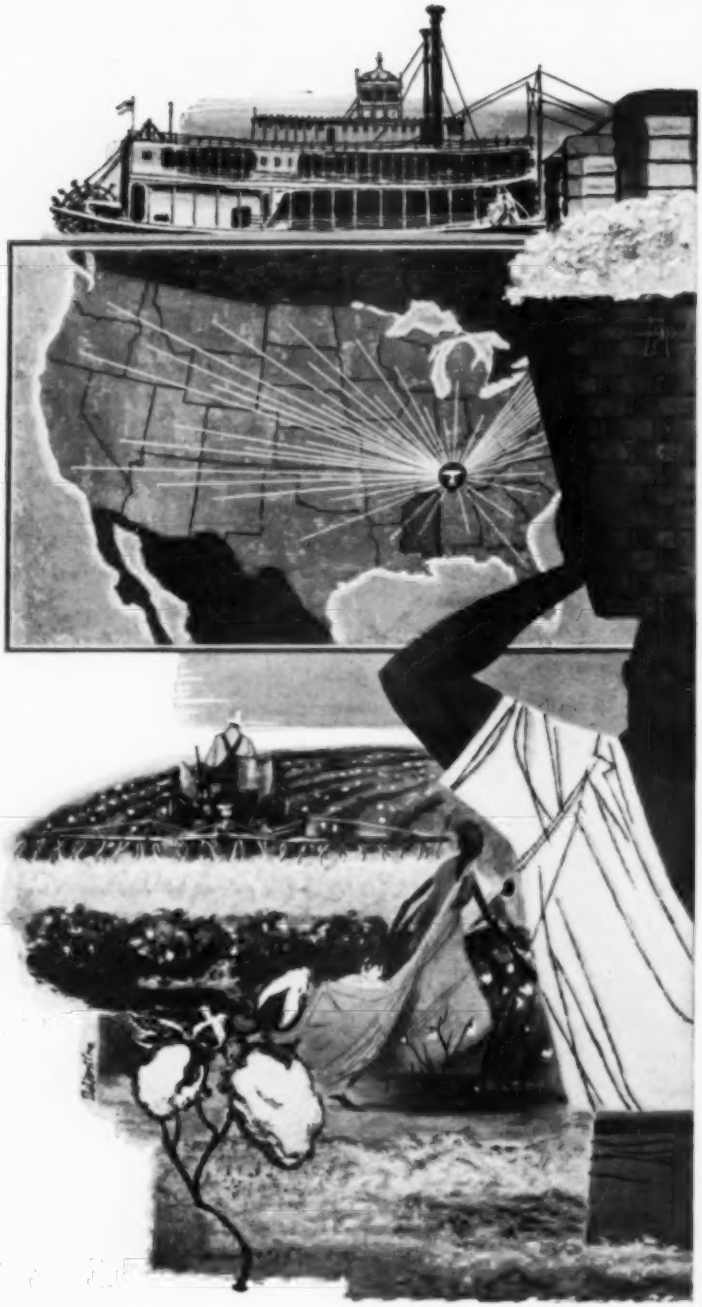
Region	1927 Percent of Total	1938 Percent of Total	1950 Percent of Total
Northeast States	18.99	18.40	12.53
Corn Belt and Lake States	11.60	11.32	24.00
Appalachian States	26.39	24.59	20.81
Southeastern States	34.12	33.26	24.01
Delta States	5.66	7.18	7.68
Southern Plains States	1.24	1.22	3.91
Northern Plains States	.13	.28	1.20
Mountain States	.06	.41	1.34
Pacific States	1.84	3.34	4.52

TABLE 3

Yield per Acre Comparisons for 1927, 1938 and 1950

		Yield	Pounds of Fertilizer per Acre
Corn	1927	26.6	30.4
	1938	27.7	34.6
	1950	37.6	113.3
Cotton	1927	145.7	94.9
	1938	238.7	120.1
	1950	264.9	203.3
Wheat	1927	13.8	21.5
	1938	13.3	21.4
	1950	16.6	50.4
Tobacco	1927	771.3	474.7
	1938	865.4	630.9
	1950	1,277.2	1,599.1

THERE'S A TOUCH OF TENNESSEE IN MISSISSIPPI COTTON



Old times in Mississippi and throughout Southern cotton fields are not forgotten... times when the boll weevil claimed great portions of the cotton crops. Today dust and spray formulations protect the cotton from boll weevils and other destructive pests. The active chemical in these formulations is Benzene Hexachloride (BHC) which Tennessee Products produces in large quantities.

Protecting cotton is not all that Tennessee does in Mississippi. For instance, Tennessee ships Tensulate Insulation and Tensulate Perlite, a light weight aggregate, for the building industry. And you will find products from Tennessee in every state in the country doing a wide variety of jobs. That's why Tennessee is known from Coast to Coast as the industry that serves all industry.

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PRODUCTS & CHEMICAL
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Producers of: **FUELS • METALLURGICAL PRODUCTS • TENSULATE BUILDING PRODUCTS • AROMATIC CHEMICALS WOOD CHEMICALS • AGRICULTURAL CHEMICALS**

4.52% in 1950. The Mountain states also made a notable increase from .06% in 1927 to 1.34% in 1950.

In table 3, we observe the rate of fertilization and how it shows up in yield per acre in four important crops. The graph (Figure 2) shows more clearly the relationship between fertilizer usage and crop yield. Both have ascended at about the same rate.

However, the question arises, are farmers using enough fertilizer for maximum economical production? They consumed some 19½ million tons of fertilizer materials last year. Figure 1 indicates the actual use of fertilizer in 1950 as compared to the recommended amounts. It shows that if these recommendations were heeded, 688 million bushels of corn, 2.7 million bales of cotton, 133 million bushels of wheat and 2,927,000 tons of beef might be added to our annual production.

The fertilizer industry is of course in agreement that farmers must use more commercial plant food if yields are to be stepped up further and if we are to maintain the productivity of soil. The downward trend in organic matter must be stopped.

Growing more organic matter is the only practical and economical way to increase or maintain it. Since this requires the production of abundant crops, it in turn calls for generous use of fertilizer materials. Some experimental data will serve as an illustration:

During a 15-year test of 4 clean-culture crops, 5 small grains and 6 hay crops at the West Virginia Agricultural Experiment Station, 5 tons of fertilizer raised the total crop yields from 41,000 to 118,000 pounds per acre. But it also greatly increased the organic-matter content of the soil, because of the much greater amount of roots and stubble that were left in and on the soil after the crops had been harvested. The increase in organic matter in the plow depth of soil amounted to 3,600 pounds for each ton of fertilizer applied. If the subsoil had been examined as well, several hundred additional pounds gain in oragnic matter would certainly have been shown. It seems safe to

(*Turn to Page 125*)

1950 Actual FERTILIZER USE in U.S. vs. Recommendations

Crop	Used LBS./A	Recommended LBS./A	Additional Yield Possible
Corn	113.3	244	688,000,000 bu.
Cotton	203.3	351	2,700,000 bales
Wheat	50.0	101	133,000,000 bu.
Grasslands	21.5	158	2,927,000 tons of Beef

Figure 1

DEATH RATE PER 100,000 POPULATION vs FERTILIZER USE, 1946
(FEDERAL SECURITY AGENCY - PUBLIC HEALTH FIGURES)

STATE	HEART DISEASE	CANCER AND OTHER MALIGNANT TUMORS	FERTILIZER USE RANK
NORTH CAROLINA	183.5	69.3	1
GEORGIA	189.5	78.0	2
SOUTH CAROLINA	185.4	70.0	4
VIRGINIA	249.1	92.7	8
UNITED STATES	306.8	130.1	

Figure 3

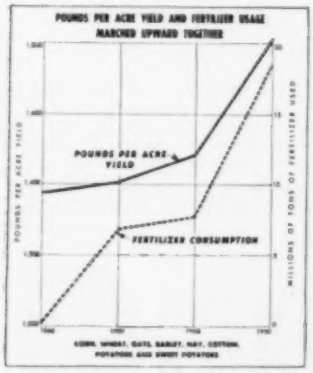

POUNDS PER ACRE YIELD AND FERTILIZER USAGE MARCHED UPWARD TOGETHER
POUNDS PER ACRE YIELD
FERTILIZER CONSUMPTION
MILLIONS OF TONS OF FERTILIZER USED
CORN, WHEAT, OATS, BARLEY, HAY, COTTON, POTATOES AND SWEET POTATOES

Figure 2

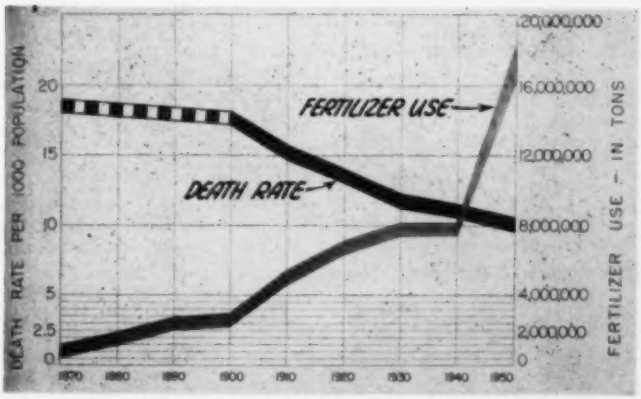
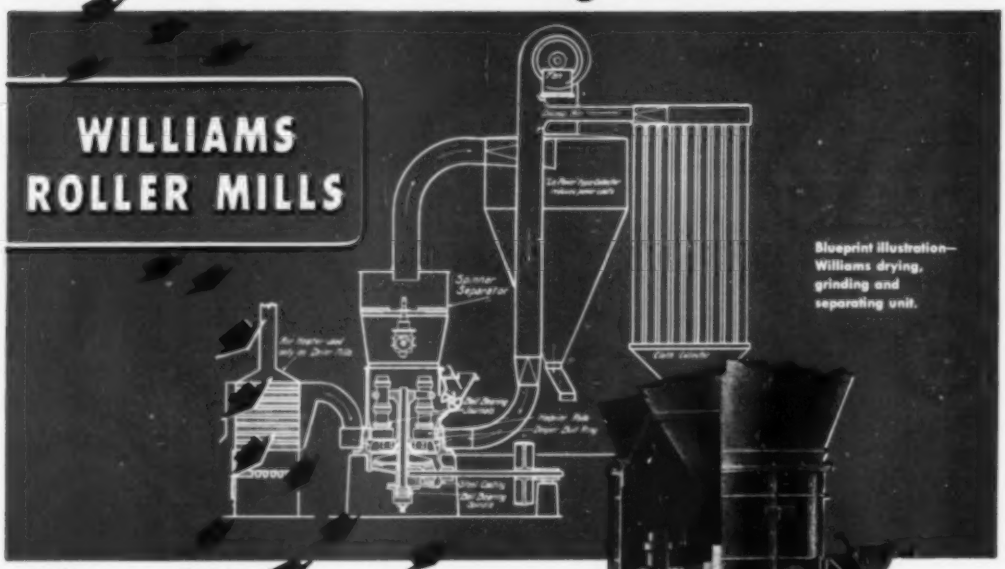


Figure 4

For those Fine Grinding Jobs . . .



Blueprint illustration—Williams drying, grinding and separating unit.

200 to 325 mesh Grinding

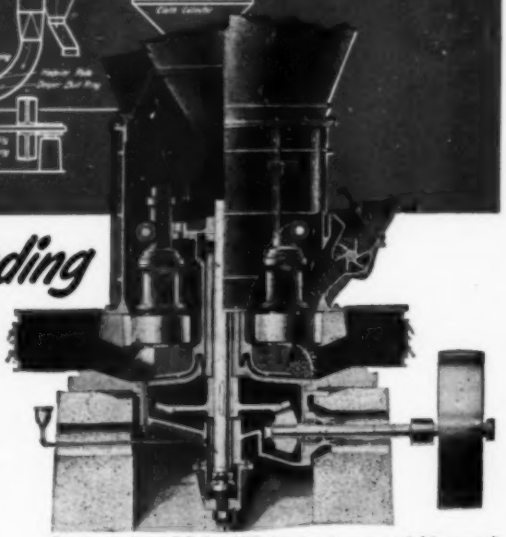
Fine grinding of insecticide powders can ONLY be done economically with PROPER fine grinding equipment and we believe the Williams Roller Mill with Air Separation is the finest mechanical method of material reduction on the market today.

Experienced, engineering know-how, embodied in the design of the unit permits the production of high concentrations of DDT, BHC, Toxaphene, etc., — thoroughly blended. Also pulverizes Pyrethrum, Rotenone, Sulphur for Dusting and Gypsum, Limestone, Rock Phosphate and similar products on an around-the-clock schedule.

Control of product size is assured with the Spinner Air Separator. Finenesses of 98% and 99.9%, 325 mesh are obtainable and can be consistently maintained. A clean, dustless installation from feed opening to finishing product bin, all automatically handled, makes this unit additionally desirable for your plant.

Williams Roller Mills are available in a full range of sizes.

WC-RT-1



Sectional view of Roller Mill showing how material is ground between rolls and bull ring, then air swept to Separator which extracts fines and returns oversize for re-grinding.

WILLIAMS ALSO MAKES . . .

Heavy Duty Hammer Mills for crushing and grinding rock phosphate, gypsum, limestone . . . also for disintegrating ammonium sulphate lumps and fertilizer mixes that "set-up" in storage. The Hellx-Seal Pulverizer for disintegrating and blending insecticide mixes and concentrations ready for use.

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WILLIAMS

CRUSHERS GRINDERS SHREDDERS

Spray Residue Problems

by
George C. Decker*
Illinois Natural History Survey
Urbana, Illinois

THE whole problem of chemical additives in foods is, of course, one of the highly controversial subjects of our day. Literally hundreds of chemicals find their way into foods in one way or another. Some are deliberately added to impart some desirable attribute, such as flavor, color, or keeping quality, to a specific food product. These are frequently referred to as intentional additives. Others, often referred to as incidental additives, find their way into foods more or less accidentally or in some way incidental to the production and processing of these foods. Spray residues of insecticides, fungicides, plant growth regulators, etc., fall in the latter category of incidental additives.

Food producers, those concerned with the marketing of crops, and the eventual consumer are all in one way or another vitally interested in some phase of the residue problem. At times segments of the consumer group, or more especially, certain self-appointed agents who feel compelled to see that the public food supply is in their own opinion, adequately protected, present arguments that verge upon the fantastically absurd. They may even insist that no foreign chemicals should be permitted in foods and that the use of insecticides and fungicides is unnecessary or unwarranted and should be drastically restricted or not permitted at all. *On the other hand*, a few growers and custom spray operators appear to have the philosophy of "Let the buyer or consumer look out for himself," and they seem to feel that it is no one else's business what chemicals they use or how they use them. These diametrically opposite views are, of course, equally absurd. The very fact that such wide differences of opinion do exist is ample proof that some sort of official supervision or legislative control over the chemicals permitted in foods is necessary. As a matter of fact, we have a number of laws bearing on this subject, but before going into the subject of laws and regulations, I think we should consider two other phases of this over-all problem.

The Evaluation of Hazards Involved in the Use of Pesticides

BEFORE attempting to enumerate and evaluate the various hazards inherent in the use of pesticides, we must recognize and rather thoroughly understand a few more or less axiomatic principles. In the first place, we must recognize that practically all pesticides have toxic properties and are toxic to warm-blooded animals, including man, as well as to insects. If they did not have these properties, they probably would not control pests and therefore would not be good pesticides.

The fact that most pesticides are toxic to man and animals does not necessarily mean that they cannot be used safely. If we develop a proper respect for the toxic properties of a substance, it may frequently be used with greater safety than a much less toxic substance which is apt to be handled carelessly. Let us recall that livestock handlers are seldom gored by the notoriously vicious bull; it is the supposedly gentle, harmless bull that catches the farmer, his wife, or child off guard.

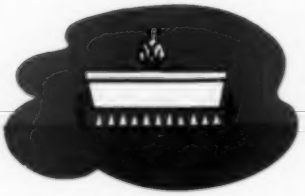
A careful distinction must be made between hazards and toxicity. Toxicity is the capacity of a substance to produce injury; hazard is the probability that injury will result from the use of the substance in the quantity and in the manner proposed. To be at all reliable, an estimate of the hazard involved in the use of any substance must be based not only upon a knowledge of its inherent toxicity, but upon the details of its proposed use, as well.

If we are to avoid confusion, we must also distinguish between use or operation hazards and residues or food hazards. In other words, the hazards associated with residues and food contamination may not be related to and should not be confused with the accident or other hazards

*Before 3rd annual short course for Custom Applicators and Pesticide Manufacturers and Distributors, Auburn, Ala., Feb. 26.

DAVISON GRANULATED Superphosphate 3 WAY CONTROL

STORAGE CONTROL—No caking or lumping while in storage.



APPLICATION CONTROL—No dusting or bridging; drills free and even.

FOOD CONTROL—Supplies plant food at a uniform rate.

Now it is possible for you to store superphosphate without fear of its caking . . . that is, if it is DAVCO GRANULATED SUPERPHOSPHATE. DAVCO Granulated Superphosphate will not become hard or caked . . . it is easier to apply in the field because there is no dusting or bridging over in the drill.

DAVCO Granulated Superphosphate gives complete coverage in the field . . . drilling freely and evenly . . . supplying each plant with a uniform quantity of nutrient phosphorus.

Get DAVCO Granulated Superphosphate . . . the superphosphate that gives you the added sales points through its 3-way control.

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associated with manufacturing or application practices.

In general, use or occupational hazards are related to acute toxicity and may be measured in terms of the acute toxicity of the pesticide and the degree of exposure to it. Here we must consider the possibility or probability that men engaged in the manufacture, processing, or application of a pesticide or pesticidal chemical will be injured or seriously affected by an overdose of the substance, acquired either through accident or carelessness in handling the material. The users and potential users of substances having a high acute toxicity should be fully informed through proper labeling and instructions as to the hazards involved and precautions to be observed. From this point on, individuals should be at liberty to make a free choice from the materials available and assume full responsibility for their actions. Where highly dangerous chemical or mechanical tools are used, a condition of calculable risk prevails, and some accidents may be expected. Actually, all such accidents are deplorable and every reasonable effort should be made to reduce operational hazards to a minimum. At the same time, pesticide usage need not be singled out for special condemnation, for it should be recognized that the number of farm accidents involving the use of pesticides and other chemical tools is insignificant when compared with the number of farm accidents involving the use of mechanical tools.

Food contamination or residue hazards are, in general, closely related to the chronic toxicity of the pesticidal chemical involved, and may be measured in terms of the chronic toxicity of the chemical and the amount of the residue remaining on or in the food reaching the consumer. The inherent toxicity of a pesticide or a pesticidal chemical to warm-blooded animals may have little or no direct bearing on the final food hazards. Many of the more toxic materials are applied at times when the edible portion of the crop is not exposed. Also, as a rule, such chemicals are applied in proportionately smaller amounts than are less toxic materials, and frequently the more toxic compounds are short-lived. In other words they are quickly destroyed through chemical change or lost through erosion or evaporation. It would not, therefore, be in the public interest to deny agriculture access to valuable pesticides strictly on the basis of their inherent toxicity to warm-blooded animals. Expressing this same thought in another way, food producers should not be denied the right to use a pesticidal chemical, no matter how poisonous, provided its use as recommended does not endanger the public health.

Factors that Determine Residue or Food Hazards

BASICALLY, only three factors are involved in determining the food hazard where pesticides are used in the production and processing of food products.

1. The chronic toxicity of the pesticidal chemicals used, which is a measure of adverse effects resulting from prolonged ingestion of small amounts of a deleterious substance. Acute toxicity will rarely be involved.

2. The number of sources from which the same or related substances might be obtained, or the percent of the average diet that might be contaminated.

3. The magnitude of the residue—in other words, the actual amount of the pesticidal chemical remaining on or in the food when it reaches the market or is ready for consumption.

The first two factors mentioned will be determined by the toxicologists and food technicians and we will be primarily concerned with the third, or residue problem.

Factors that Determine the Magnitude of a Pesticide Residue

PESTICIDES vary greatly in their physical properties and their application may vary greatly as to time, method, and amount. The presence or absence of a chemical residue at harvest time, therefore, will be determined by a number of factors entirely independent of the toxicity of the chemical itself. Such factors, perhaps but not necessarily in the order of their importance, would include:

1. *Rate of application.* You will recall that some pesticidal chemicals are applied at the rate of 1 to 2 pounds per acre, whereas others are normally applied at the rate of ⅛ to ¼ pound per acre, or even less. If all other factors were equal, one might expect residues at any given time to be more or less proportional to the original rates of application. For any given pesticide subjected to identical conditions of exposure, this would usually be the case. However, where two or more insecticides are being compared, other important factors often overshadow rate of application in determining the residue.

2. *Rate of loss.* The specific chemical and physical properties of the individual pesticidal chemicals used in any series of treatments will, to a very large extent, determine the rate at which the residues of each of these chemicals will disappear from treated surfaces. Where a series of unrelated chemicals is involved, the rate of residue loss is perhaps the most important single factor in determining the relative magnitude of their residues at any given interval after treatment.

Some pesticides, such as pyrethrins, rotenone, and tetraethyl pyrophosphate are highly unstable and are quickly detoxified or lost through decomposition or degradation, whereas others, such as the arsenicals and DDT, can persist unchanged over long periods of time.

It is even more important that we recognize variations in rates of evaporation. Some insecticides, such as parathion, lindane, and aldrin, are quite volatile and tend to disappear rapidly, so that comparatively heavy deposits will, for practical purposes, disappear completely in about two to three weeks. On the other hand, such insecticides as DDT and toxaphene are considerably less volatile, and fruits or vegetables treated with these chemicals, with comparable initial deposits and identical conditions of exposure, would continue to show significant residues one month or even two months after treatment. In most

THREE ELEPHANT
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PENTAHYDRATE BORAX
COMPOSITION Contains a minimum of 44% B_2O_3 or approximately 121% equivalent Borax.
ADVANTAGE More economical because the Borate in this form is more concentrated.
PURPOSE To correct deficiency of Boron in the soil.
RECOMMENDED USES As an addition to mixed fertilizer, or for direct application to the soil.
FOR CORRECT APPLICATION Consult your local County Agent or State Experimental Station.
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TRONA
MURIATE OF POTASH
IMPORTANCE Muriate of Potash is a vitally important ingredient which provides the soil nutriment so essential in the formulation of good mixed fertilizers.
PURPOSE To help resist plant diseases and enhance the productivity of crops.
TO ASSURE EFFECTIVE RESULTS Specify "Trona" Muriate of Potash . . . made by the pioneer producers of Muriate in America.
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3030 WEST SIXTH STREET LOS ANGELES 54, CALIF.

cases the rate of residue loss for a given chemical under a given set of conditions is or approximates a straight line logarithmic function of time.

Under this heading we must also consider that some losses are attributable to erosion resulting directly or indirectly from rainfall, wind, handling, brushing, etc.

3. *The time of pesticide application.* Here, in most instances, we would be concerned with the time lapse or number of days between treatment and harvest, but at times the presence or absence of exposed edible portions of a plant would be an important consideration.

4. *Formulation.* In general, the formulation in which an insecticidal chemical is prepared will frequently affect materially both the magnitude of the original deposit and the rate at which that deposit will disappear. For example, DDT residues produced by the following formulations would tend to disappear in the order named: Dusts, wettable powders, emulsions, and oil solutions.

5. *Miscellaneous.* Several factors which might at times be important and at other times trivial or nonexistent would include (a) residue dilution due to plant growth; (b) absorption of the chemical by plant parts or plant substances; and (c) the availability and use of practical residue removal methods. In some cases the number of repeated applications of the same chemical will be a factor, but as a rule the date of the last treatment will be most important.

It is, I hope, obvious that the several factors mentioned above will seldom if ever be operating singly, but always in combinations of at least two, three, or more factors. In attempting to decide which of two or more insecticides would be the safest to use, one must consider all of the factors. For example, we have a bad infestation of grasshoppers to control. Two chemicals are available to do the job. Insecticide A is reportedly relatively non-toxic to animals. It would normally be applied at the rate of 1 or more pounds per acre. Insecticide B is reportedly a dangerous material to use, 8 to 10 times as toxic as A to animals. It is normally applied at the rate of 0.25 pound per acre. A study of their residue loss curves shows that Insecticide B disappears about seven times as fast as A. Now, then, if you use 6 times as much of Compound A and its rate of residue loss is only 1/7 as fast as B, it would appear that the relative time required to reach a residue of X magnitude would be about 42 to 1 in favor of Compound B. Then, even granting a 10 to 1 difference in toxicity in favor of A, Compound B may still be the safest one to use.

While we are considering the hazards, we must consider psychological hazards and other unnatural or unreal hazards as well as actual hazards. We have had so much adverse publicity on pesticide hazards that many people are so scared of pesticides that when exposed to anything they worry themselves into a state of illness. Then there are those who want to find some excuse to recover damages and they will make false or confused claims. It is almost a safe bet that if a new chemical has been used in an area, there will be no normal illnesses or animal losses for some time. Everything possible will be charged to the new chemical. Sometimes it will be difficult to establish the real facts and prove nonresponsibility. Many examples of this could be cited.

Claims of damage due to drift of materials are common, but mostly unjustified. Of course, we all know and readily admit that drift does occur. In the case of herbicides and plant growth regulators, we know that damage to adjacent crops is not uncommon. Serious trouble from drift of insecticides is much less common. Bear in mind that drift is directly proportional to the wind velocity and inversely proportional to droplet or particle size. Every operator should, therefore, keep these two important factors well in mind and conduct his operations accordingly.

The death of animals in adjacent fields or even the illness of animals or humans can seldom be honestly attributed to pest control operations on nearby property. With most pesticides, the margin of safety is such that animals and men have worked continuously in the treated areas without mishap. Why, then, should it be probable that the small amount that drifts to another field will be dangerous? In animal toxicity studies one finds that animals may be fed 20 to 50 or even 100 or more parts per million of DDT or some of the other chlorinated hydrocarbons in their food for several days, weeks, or even months before any ill effects are noted. That would indicate that with normal residues it would be indeed difficult to kill or seriously affect animals even in a treated area in any reasonable length of time. They may and probably will be storing chemicals in fat, but they should not quickly show symptoms of poisoning. Let us take the case of dieldrin, supposedly a dangerous material to use. Applied at the rate of ¼ pound per acre, we have 113,390 mg. per acre. If the acute toxicity rating is 60 mg./kg., a 1,000 pound steer will have to eat 30,000 mgs., or all the dieldrin that fell on ¼ acre at one meal to get an acute case of poisoning. Similar values would be about 0.3 acres for DDT, ½ acre for lindane, and 4 acres for methoxychlor. Do you have any such animals? I know of no proven cases where animals have been killed by feeding on forage contaminated by drift. Animals have died of insecticide poisoning, but always, so far as I have been able to learn, they had access to large amounts of poison as a result of accidents or carelessness. I cite these figures only to strengthen our common cause in fighting and disproving unjust claims. Do not under any circumstances let this would-be assurance lead you to become careless.

Regulation of Pesticide Usage and Residues

NO doubt there are individuals who will raise the question, "Do we need any type of regulation or control of pesticide usage," but if we are to judge the future actions of man on the basis of his past performance, apparently we do. If all mankind would observe the so-called

(*Turn to Page* 155)

ETIWAN FERTILIZER is a name familiar to thousands of Carolina farmers. Recent improvements at this Charleston plant have given Etiwan one of the South's most modern fertilizer facilities. Production has been increased by the installation of dual measuring tanks. These save time usually lost in refilling the tank after each batch; also cut an operator's motions by 50%.

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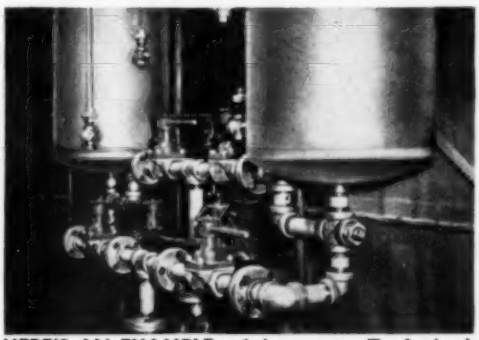

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America's Growing Name in Chemicals

Office of Materials and Facilities, PMA, having completed a nation-wide survey, here reports its findings on estimated quantities of various pesticides needed in different states and regions of U. S.

Estimated Requirements for Pesticides, 1952

by

H. H. Shepard

U. S. Department of Agriculture
Washington, D. C.

HAVING available an adequate supply of pesticides is of utmost importance for the protection of agricultural crops and to insure producers against losses of seed, fertilizer, labor, the use of land and equipment and stocks of harvested foodstuffs. This has been proved true in the past, and is even more important at the present time with a world-wide need for extra food and fibre. In this report, the word "pesticide" is used for any chemical or mixture of chemicals used as an insecticide, fungicide, herbicide or rodenticide. Also, defoliants for cotton and some other crops are considered in this paper, as pesticides.

Until the establishment, late in 1950, of a staff office to study the pesticide situation, few reliable statistical data were available on the quantities of pesticidal chemicals used by domestic agriculture. Such information maintained on a current basis is absolutely necessary for estimating pesticide requirements. This is being done by the Office of Materials and Facilities, a branch of the Production and Marketing Administration of the U. S. Department of Agriculture.

Estimated pesticide requirements are submitted to the National Production Authority by the U.S.D.A. as claimant for pesticides and miscellaneous chemicals for domestic agriculture.

The requirement of a pesticide is the quantity of that material estimated to be needed to provide protection under conditions at least as severe as those experienced during the recent history of the particular pesticide. The Office of Materials and Facilities estimates this require-

Table 1
Quantities of Certain Pesticides Estimated to Have Been Used by Domestic Agriculture during the Crop Years 1949-50 and 1950-51, and Estimated Reqirements for 1951-52

Pesticide	Quantity Used		Estimated Requirements
	1949-50	1950-51	1951-52
	1,000 lb.	1,000 lb.	1,000 lb.
Benzene hexachloride (12% gamma basis)	71,500	80,000	95,000
DDT	59,000	78,000	85,000
Calcium arsenate	38,789	39,276	45,000
Lead arsenate	28,600	31,509	30,000
Parathion	2,551	4,670	7,000
2,4-D	17,600	23,494	28,000
2,4,5-T	(no data)	2,822	6,000

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ment for each chemical by multiplying the quantity used during the previous crop year by a percentage factor. This factor is derived by the accumulation of individual State estimates of expected percentage shifts in usage, and is intended to reflect the farmers' plans and preferences, as evaluated by persons in the several States familiar with the situation. Consumption or quantity used is calculated for each material from data provided by the basic producers and by governmental agencies, these figures being checked against accumulated State estimates of the quantities used during the same period.

State By State Survey Made

EARLY in 1951, a pesticide survey at the State level was made under the sponsorship of the State PMA Committees and the Insular Area Offices of PMA. For the most part the estimates were based on work of technical advisory committees including subject-matter specialists of the land grant colleges, State experiment stations and extension services, U. S. Department of Agriculture representatives in each State, and other competent persons. Members of the pesticide industry were also consulted in many States. Reports were made covering twenty categories of pesticides. In a similar survey just completed in 1952, there were 55 categories including several agricultural chemicals which would not be classed as pesticides.

This is the first time that pesticide surveys have been attempted on such a scale to provide a basis for determining national requirements. The attempt has been highly successful. The results have encouraged some States to make more complete surveys within their own boundaries.

Table 1 shows comparative consumption figures for seven major representative pesticides, together with estimates of requirements for these materials for the crop year 1951-52. The crop year is the period beginning October 1 of one calendar year and ending September 30 of the following year. In those cases in which the requirements figures have not been derived exactly as stated in a previous paragraph, differences are due to certain adjustments based upon information not presented in this article.

Each of a considerable number of important pesticides is produced by a single manufacturer. For obvious reasons, quantitative statements of the amounts estimated to have been used and required are not given for these materials individually. It may be of interest that combined domestic requirements for aldrin, chlordane, dieldrin, and toxaphene are estimated to be 91,500,000 pounds for the crop year 1951-52, an increase of 29 percent over 1950-51 usage of these four materials. It is believed that 1952 requirements of organic miticides, exclusive of parathion and TEPP, will amount to possibly more than 3,000,000 pounds.

Based on the proportion of the total quantity of grain reported to

Table 2. Estimated Regional Requirements for Pesticides in the Crop Years 1950-51 and 1951-52, Expressed in Percentage of the Quantity Estimated to have been used during the Previous Year

PESTICIDE	NEW ENGLAND AND MIDDLE ATLANTIC STATES		SOUTHEASTERN STATES		SOUTH CENTRAL STATES		NORTH CENTRAL STATES		ROCKY MOUNTAIN STATES		PACIFIC COAST STATES		TERRITORIES		TOTAL REQUIREMENTS	
	1950-51	1951-52	1950-51	1951-52	1950-51	1951-52	1950-51	1951-52	1950-51	1951-52	1950-51	1951-52	1950-51	1951-52	1950-51	1951-52
INSECTICIDES:																
Aldrin	147	191	104	100	245	120	235	143	166	81	109	109	-	430	203	109
Arsenic	-	245	-	141	-	130	-	174	-	316	-	162	-	-	-	170
Benzene hexachloride	114	107	132	107	148	120	103	166	207	120	106	137	299	58	135	114
Calcium arsenate	99	109	112	110	141	114	100	81	-	99	120	94	100	182	131	112
Chlordane	106	57	163	111	149	101	264	103	67	114	123	107	29	100	147	105
Chlorinated propane derivs.	-	94	-	216	-	-	-	101	-	114	-	90	-	144	-	150
DDT	104	99	129	115	151	106	129	110	157	109	116	104	115	126	128	107
DDT (TDE)	-	118	-	306	-	105	-	120	-	114	-	102	-	100	-	116
Dieldrin	-	140	-	193	-	714	-	360	-	116	-	146	-	-	-	144
EPN	-	133	-	102	-	-	-	123	-	204	-	124	-	96	-	133
Ethylene dibromide	-	130	-	192	-	-	-	132	-	255	-	110	-	76	-	130
Ethylene dichloride	-	122	-	100	-	100	-	100	-	103	-	100	-	-	-	100
Grain fumigants (liquid)	132	101	131	142	100	126	110	91	138	99	105	120	-	790	107	110
Lead arsenate	95	96	108	99	-	100	97	102	105	100	111	100	100	172	101	99
Methoxychlor	-	130	-	115	-	104	-	135	-	119	-	133	-	110	-	122
Nicotine sulfate	-	99	-	100	-	100	-	87	-	100	-	98	-	124	-	97
Paradichlorobenzene	-	95	-	100	-	100	-	88	-	100	-	147	-	100	-	96
Parathion	198	111	144	100	118	98	111	129	119	109	108	116	134	127	147	140
Pyrethrum	126	136	109	104	100	104	106	109	94	111	114	101	100	-	108	107
Rotenone	111	98	108	115	110	104	120	113	104	103	120	98	112	814	113	108
TEPP	115	102	147	109	105	100	130	108	146	121	122	105	110	100	123	104
Toxaphene	150	141	146	144	151	116	467	145	147	139	177	136	1159	141	161	130
FUNGICIDES:																
Copper compounds	102	104	110	98	102	107	98	101	110	100	105	100	172	123	102	101
Dithiocarbamates	107	110	117	114	100	105	100	110	110	107	100	103	101	130	110	106
Lime-sulfur, dry	-	59	-	100	-	-	-	96	-	107	-	100	-	-	-	76
Lime-sulfur, liquid	-	82	-	102	-	120	-	100	-	109	-	100	-	100	-	93
Organic mercurials	-	101	-	109	-	105	-	105	-	100	-	100	-	102	-	116
Pentachlorophenol	-	102	-	109	-	112	-	112	-	113	-	1571	-	101	-	109
Sulfur (conditioned)	102	107	110	108	152	109	90	115	130	132	138	102	110	94	123	106
HERBICIDES AND DEFOLIANTS:																
Ammonium sulfamate	-	109	-	104	-	101	-	101	-	104	-	104	-	230	-	104
Borax	-	125	-	110	-	101	-	121	-	103	-	109	-	117	-	110
Calcium cyanamide	-	95	-	131	-	125	-	106	-	3	-	100	-	-	-	139
2,4-D	138	104	163	116	1364	102	140	113	107	111	125	101	100	106	148	113
Dinitro compounds	99	211	100	135	500	460	87	137	103	125	100	101	477	-	139	130
IPC	-	117	-	100	-	600	-	107	-	-	-	132	-	-	-	131
Potassium cyanate	-	110	-	112	-	100	-	136	-	101	-	200	-	-	-	131
Sodium chlorate	-	105	-	100	-	179	-	105	-	94	-	100	-	100	-	106
Sodium cyanamide, mono	-	130	-	200	-	150	-	-	-	200	-	103	-	-	-	151
TCA	-	112	-	147	-	200	-	145	-	124	-	149	-	118	-	225
2,4,5-T	-	102	-	116	-	134	-	190	-	115	-	115	-	225	-	193
MISCELLANEOUS:																
Phenothiazine	-	105	-	109	-	110	-	115	-	103	-	105	-	150	-	112
Sodium fluoride	-	101	-	108	-	100	-	106	-	91	-	114	-	-	-	100

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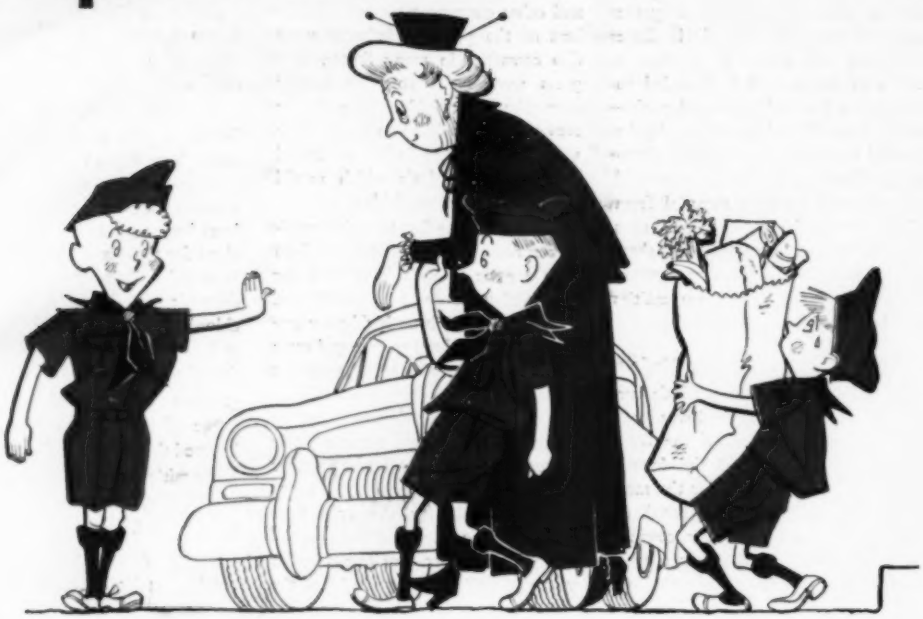

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be in storage on December 31, 1950, which would probably have required fumigation and on the usual practices for fumigation in mills and warehouses, the Office of Materials and Facilities estimated that 2,832,000 gallons of liquid grain fumigants would have been required in 1951. The cumulative estimate of requirements for liquid grain fumigants developed from the 1951 State pesticide survey was 2,845,000 gallons. The quantity of liquid grain fumigants used during 1951, according to estimates made during the 1952 pesticide survey, was 2,674,050 gallons, and the requirement for 1952 is estimated to be 110 percent of the quantity used during the previous year. The estimated requirements for liquid grain fumigants developed by independent sources are in remarkably close agreement and are confirmed by estimates of the quantity used during the period.

Copper Fungicides

COPPER fungicides comprise a major pesticide requirement which appears to be rather uniform from year to year. Although their consumption on the basis of copper sulfate may be not much over 90,000,000 pounds in some seasons, as much as 105,000,000 pounds have been used in other years, hence the latter figure is taken as the domestic agricultural requirements of copper sulfate from which bordeaux mixture, basic copper sulfate, and a number of other copper fungicides are made.

Sulfur Use Greater

SULFUR has for many years been used in large quantities to control scale insects, spider mites, apple scab, and various other pest organisms. Without industry reports as to usage of pesticidal sulfur, such estimates of sulfur consumption in this field as have been made in the past appear generally to have been too low. The results of the State survey in 1951 indicated usage in the 1949-50 crop year to have been 392,600,000 pounds with an expected 23 percent increase to 483,300,000 pounds in 1950-51. Survey estimates for 1952 evidently were influenced by the need for sulfur conservation. Sulfur grinders reported to the National Production Authority, however, that appreciably greater quantities were used in the formulation of conditioned sulfur and other sulfur mixtures than these estimates showed.

Consumption of lead arsenate at present appears to be uniform at about 30,000,000 pounds a year. The manner in which this insecticide continues in rather large and extensive use is a surprise to many entomolgists. Calcium arsenate consumption, as would be expected, fluctuates with the status of boll weevil infestations against which it is used regularly by many growers despite the advent of newer materials for this purpose.

Imports of rotenone-bearing roots have averaged slightly more than 7,000,000 pounds annually for the last four calendar years. It is believed this figure might be considered a fair estimate of present average requirements of this material. Rotenone is essential in cattle grub control and is utilized extensively on certain truck crops.

About 20,000,000 pounds of dithiocarbamate fungicides are expected to be used in domestic agriculture in the crop year 1951-52. They appear to be in growing demand. In case of more severe shortages of copper or sulfur fungicides, these chemicals would have a further important role.

Many other important pesticides for agricultural use, such as methoxychlor, DDD (or TDE), and sodium trichloroacetate (TCA), are employed in quantities ranging from 100,000 to 2,000,000 pounds. Numerous valuable pesticidal chemicals are still undergoing development, and it is not practicable to assess their quantitative requirements at this time.

Phenothiazine and sodium fluoride have been almost entirely displaced as insecticides by other materials. Agricultural requirements for these materials, however, continue without serious reduction, since both are now used as anthelmintics for livestock. The combined estimated requirements for phenothiazine and sodium fluoride for anthelmintic use is over 5 million pounds each year.

Regional trends, as indicated by the State surveys, in the estimated quantities of pesticides required during the crop year 1950-51 and for the crop year 1951-52, expressed as a percentage of the quantity used in each case during the previous year, are shown in table 2. In this table, the States are grouped into six regions and the territories. The New England and Mid-Atlantic region includes the States south through Virginia and westward through Pennsylvania, and West Virginia. The Southeastern region includes States east of the Mississippi River and north through Tennessee and the Carolinas. The South Central region includes Texas, Louisiana, Arkansas, and Oklahoma. The North Central region includes Midwestern States through Kansas, Nebraska, and the Dakotas. The Pacific region comprises Washington, Oregon, and California, with Arizona added. The remaining States make up the Rocky Mountain region as defined for the purposes of this tabulation. The Territories have virtually no relation to each other with respect to pesticide requirements, but are added as a unit for the sake of completeness.

A study of the estimated changes in quantities of pesticides used and required reveals that rapid initial expansion is usual for new materials which have been demonstrated to be effective. Materials which have been established for a relatively long period enjoy a rather stable rate of use from year to year. Demand is influenced by anticipated shortages and by development of new major uses.★★

Although new materials quickly rate heavy demand, old, established pesticides maintain steady use season after season. Outlook is for continually increasing demand.

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New Texas Plant for Tobacco By-Products

TOBACCO By-Products & Chemical Corp. recently opened its new insecticide plant in Waco, Texas, with a day of open house attended by hundreds of local and state agricultural leaders, growers, businessmen and other invited friends. Small groups were taken through the buildings by officers of the company who explained in detail the workings of the new machinery.

Manufacturing facilities and sales offices are housed in a modern concrete-block building facing the Marlin highway. A complete product control laboratory is included inside this building, and the whole unit is air conditioned to cope with the summer heat.

Near this building is the largest unit of the plant, another concrete-block structure where the dust formulations are mixed. Adjacent to the dry unit is the company's warehouse.

Liquid insecticides are produced in a separate metal building which is connected to the dry materials building by a steam jacketed pipe line. After toxaphene or aldrin or any of the other basic insecticidal materials are melted in the liquid department, they are carried into the dust department through this pipe and are sprayed on a clay base. This of course absorbs the liquid and the material is then passed through a milling machine. It then is transported via conveyor belt to a blender where it is blended with other materials to make a complete insecticide.

As a finished product, the material is then dropped into a weigh hopper and is bagged ready for shipment.

On hand at the open house were officials of both Tobacco By-Products and Chemical Corp. and the parent company, Virginia-Carolina Chemical Corp., Richmond, Va. George F. (Grub) Leonard, executive vice-president of the subsidiary firm was busy guiding groups of people through the new plant, as was James Schofield, production manager from Richmond. V-C vice-president

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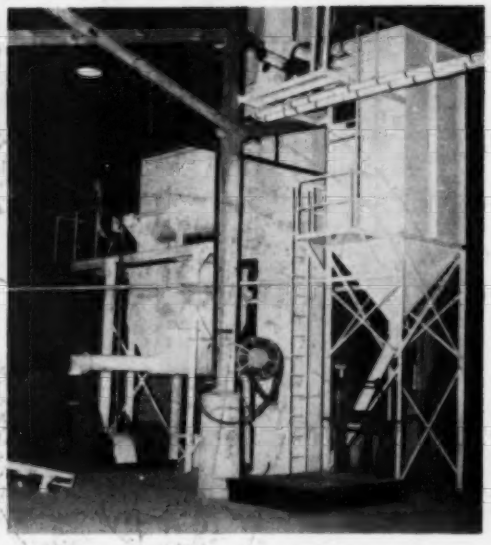

Bruce Rennie pulled the lever to fill the first bag of "Black Leaf" toxaphene-sulfur dust to be manufactured at the plant.

Territory to be served by the Waco plant includes Texas, Oklahoma and Louisiana. The firm also operates another plant in Montgomery, Alabama.

PHOTOS THIS PAGE

(Above, left): Mixing tank in the liquid insecticide unit at Waco plant. At the right (above) is seen the milling and blending unit where the firm's "Black Leaf" dusts are formulated.

Below (left): James Schofield, production manager from Richmond, points out a step in production of cotton dusts to group of visitors including C. R. Parencia and K. P. Ewing, from the U. S. Department of Agriculture office in Waco, who may readily be identified by their authentic Texan headgear.

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Washington Report

UNUSUAL problems face the pesticide industry as it enters its period of heaviest buying and use for the 1952 season. A number of factors forming the complete picture have to do with a potential over-supply of formulations, depressed prices with their adverse affect on the buying program, plus the fact that exports will not be permissible during the next three months even if the shipping out of the country should appear advisable. Last but not least, 1952 is a presidential election year, in which conditions are difficult to predict with accuracy. All of these uncertainties were adding up to a considerable amount of difficulty in the movement of materials early in April, 1952.

* * *

Inventories of finished materials in the hands of distributors, dealers and consumers have been a problem since the beginning of the season last fall. However, production of technical materials has continued at a maximum pace resulting in even greater stocks of finished materials. A mild flurry of exports during the winter succeeded in preventing a serious decline in DDT prices, but the price of BHC formulations dropped in December due to an over-supply. The price of BHC-containing materials has not recovered, but at press time, DDT prices had recovered much of the earlier weakness due to the continuing press from export requirements.

* * *

However, it is clear that BHC dusts and BHC-cotton dusts cannot recover until actual buying starts again during the domestic season. Domestic purchase and stocking of most formulations has been extremely spotty and were it not for export demand, there would have been but very little movement. As a result of the weakening of prices, there has been a demoralized buying program below the producer level. However, in order to be prepared for any eventuality, it has been necessary for technical and formulation producers to continue production in order to meet the latent demand when it develops. An attempt to correct this condition led to the December and January buy early program, sponsored by the Department of Agriculture and the National Agricultural Chemicals Association. This program was initiated in an attempt to move stocks out of the warehouses of producers into the warehouses of those further down in the distribution setup.

* * *

The Office of International Trade has evolved a logical program to assure as minimum an impact as possible on the domestic program. This plan called for pushing out of technical materials and finished insecticides prior to March 15th, and it is OIT's further policy to restrict exports during the second and third quarters of 1952 when domestic requirements will be at a maximum. Therefore, it is unlikely just now that there will be any great amount of exports permitted during the next 3 to 6 months. This inability to export, therefore, may present a serious problem to the industry should the other factors mentioned above make it necessary to dispose of stocks.

The political effects of a presidential year cannot be overemphasized. Generally, the chemical business is in a mild slump as are many other consumer businesses. The effects on agriculture and the resultant effects on the use of insecticides and fertilizers can be serious.

Some of the more important Federal actions as they affect the industry are discussed below.

* * *

Copper Sulfate: OIT had planned that there would be an allowance of approximately 70-75,000,000 lbs. of copper sulfate for export during the calendar year 1952. In 1949, 84 million lbs. of this material were exported, while in 1950, 63 million lbs. left this country, and up to September 30, 1951, there were about 60 million lbs. exported.

With increasing shortages of copper and sulfuric acid, OIT felt it was necessary to maintain the same degree of exports followed in 1950 which is generally regarded as the base year. However, there was to be a slight upward adjustment of approximately 10% to take care of more urgent overseas requirements.

* * *

Sulfur: It is now contemplated that the total amount of sulfur to be available for agricultural dusting purposes, including the use for insecticides and fungicides during 1951-52 season, would be 593 million lbs. This compares with the 1949-50 figure of 462 million lbs. and the 1950-51 figure of 524 million lbs.

* * *

DDT: OIT has indicated that it will allow approximately 20 million lbs. of technical DDT to be exported during the first and second quarters of the agricultural year. Approximately 9 million lbs. were permitted to be exported during October, November and December, with 6 million pounds additional being allocated by the middle of January and earmarked for export. An additional 2 million lbs. were made available by February 1st and the deadline of March 15th was placed as the final shipping date.

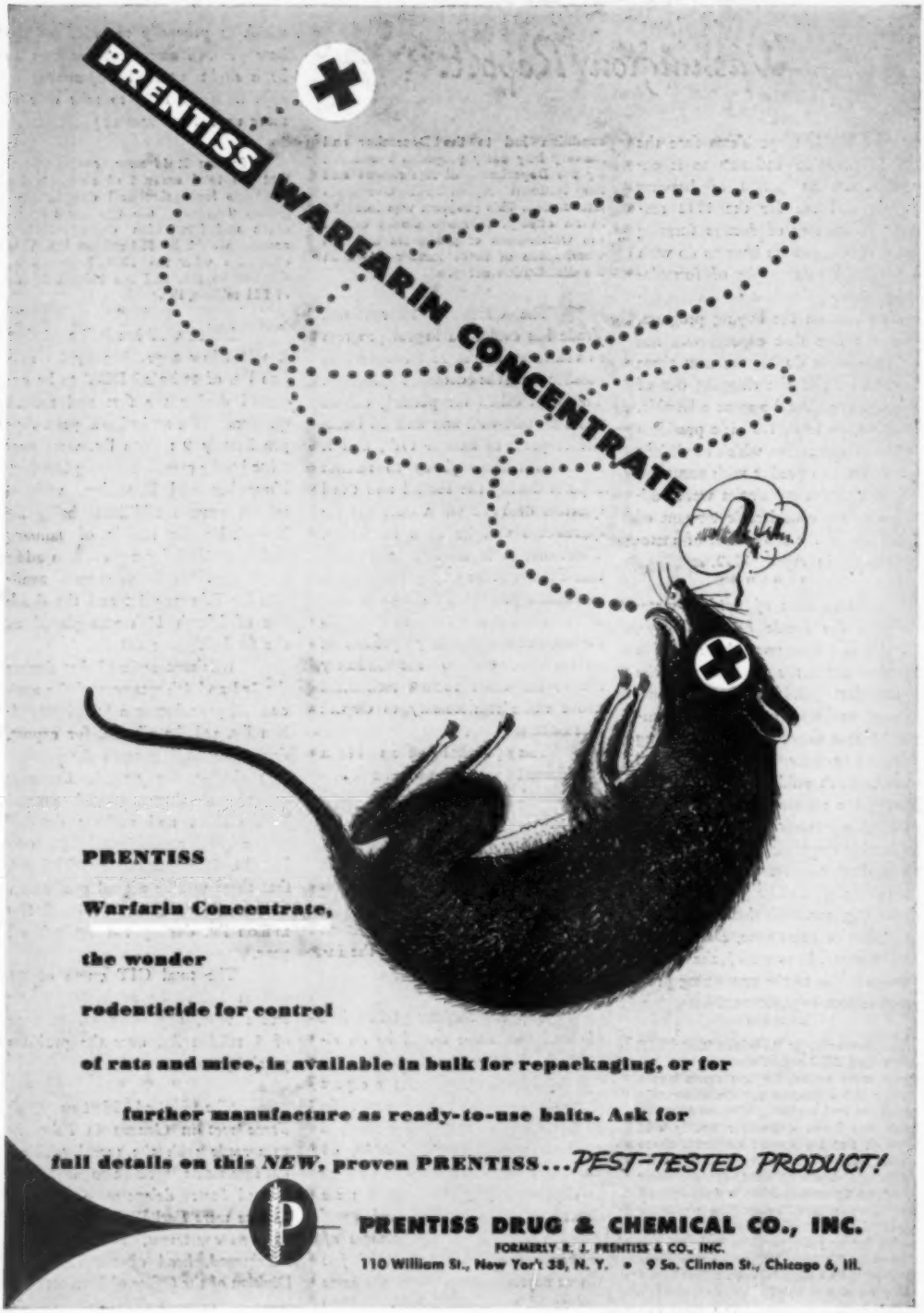
It is contemplated that during the 3rd and 4th quarters of the agricultural year, between 5 and 10 million lbs. will be allowed for export, depending entirely upon the production during the period. Domestic agricultural demands and normal U.S. civilian and military demand will require approximately 85 million lbs. It is now expected by NPA that there will be a total production of somewhere between 110 and 120 million lbs. during the agricultural year.

The total OIT quota of 25 million lbs. to be available for the entire year, represents an increase of 5 million lbs. over the previous year's quota.

* * *

The United Nations Task Force met in Geneva in February to wrestle with the world problem of insecticide production and use. United States delegates to the conference were Earl R. Beckner of the State Department, and Louis N. Markwood, head of the Chemicals Division of the Office of International

(Turn to Page 127)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Suppliers' Bulletins

Attapulgus Issues Bulletin

Attapulgus Clay Co., Philadelphia, has recently started publication of a four page bulletin entitled *Attaclay Pesticide Digest*. Featured in the September issue of the new publication is an article entitled "*Carrier and Diluent Classifications and Their Use in Selecting Materials for Pesticide Formulations.*" People in the agricultural insecticide field interested in seeing copies of the new publication regularly, may have their names placed on the mailing list by writing to Attapulgus Clay Co. at 210 West Washington Square, Philadelphia, Pa.

•

Fungicide Brochure

Mallinckrodt Chemical Works, St. Louis, Mo. has announced the development of a turf fungicide, "Calocure." The product is a formulation of mercury chlorides with synergists. "Calocure" was developed in cooperation with the Rhode Island Agricultural Experiment Station.

Its makers state that the material is designed for application in all seasons for control of dollar spot, brown patch and snow mold. Full information is available from Mallinckrodt Chemical Works, St. Louis 7, Mo.

•

New Tracto-Lift Models

Tracto-Lift Co., Kansas City, Mo., recently announced that larger sizes of their machine will be available in the future. The current models are now made with 3,000, 4,000, 5,000 and 6,000 pound lifting capacity, fork lengths from 30 to 60 inches and lifting heights to 12 feet 6 inches.

The Tracto-Lift utilizes the heavy duty industrial tractor with large tires to give maximum flotation and tractive effort with the fork truck efficiency. Large tires on the front of the Tractor-Lift are switched from the original installation to give maximum traction in the opposite direction. According to the announcement, other modifications are reversing of the transmission, tractor seat, and steering mechanism, improvement of the steering apparatus and addition of counterweights to the rear to improve stability.

•

New Pump is Announced

A new pump for tractor-mounted sprayers has been announced by Hahn, Inc., Evansville, Ind. The

pump, shown here, is the 1952 internal gear, direct-drive PTO model. The makers state that the internal gears are of solid bronze, non-clogging and adjustable for wear by removing gaskets. The pump fits 1-⅜ PTO adapter available for other sizes; is sealed to protect main bearing from chemicals and has a capacity of 8 gallons per minute at 150 pounds. Two models are available: an all bronze, or the cast iron housing model. Further information is available from the company, 315 N. Ninth Sa., Evansville, Ind.

•

New Willson Respirators

Willson Products, Inc., Reading, Pa., announced recently its new "Agri-Tepp" respirator for protection against low concentrations of pesticides containing TEPP (tetraethyl pyrophosphate) or HETP (hexaethyl tetraphosphate). The unit is said to furnish eight hours protection and can also be used for protection against parathion. It is recommended for field use only. Mixers, formulators and greenhouse operators using stronger concentrations or aerosols, should continue to use full face protection.

•

Offers Process Pump

Peerless Pump Div., Food Machinery & Chemical Corp., Los Angeles, Calif., has recently introduced a new chemical process pump, designated as "Type DS," for pumping process liquids, either hot or cold. The pump is designed for operating in moderate capacities against low, medium or high heads and particularly corrosive and abrasive liquids with solids in suspension up to 5% by volume.

The pump is delivered in two basic designs; one, grease-lubricated, the other, oil-lubricated. (Operation 250°F to 600°F is made with the oil lubrication . . . below this temperature, grease is utilized.)

Complete descriptive literature of the pump is contained in the company's bulletin No. B-1600, which can be obtained by writing Peerless Pump Division, Food Machinery & Chemical Corp., 301 W. Avenue 26, Los Angeles 31, Calif.

•

Air-O-Fan Booklet

Air-O-Fan Products Corp., Gilroy, Calif. has available a booklet describing the Air-O-Fan line of spraying and fogging equipment. The machines are available in various models to cover orchard spraying requirements. The bulletin states that the machines are effective in all types of orchards, providing 100% coverage for both deciduous and non-deciduous trees. The principle of operation of the Air-O-Spray machines involves an air stream of large volume and relatively low velocity. An Air-O-Duster attachment is available at only a fraction of the cost of a separate machine, according to the bulletin.

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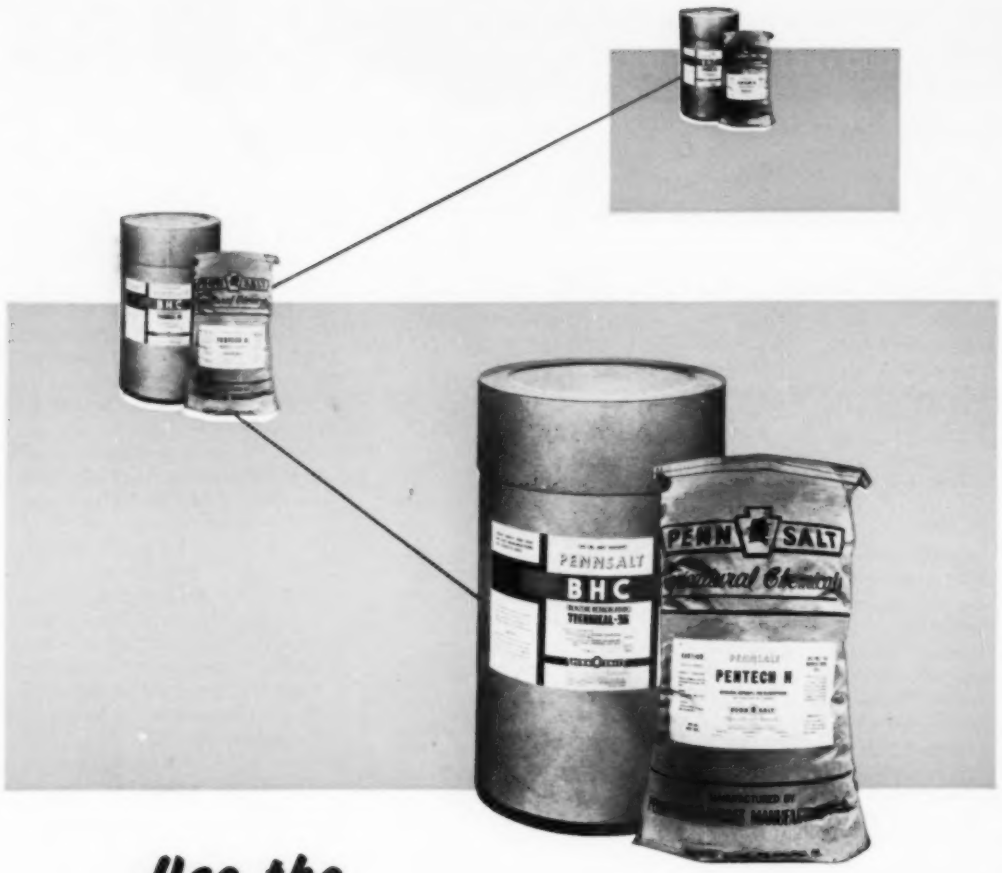
New Carbide Material

A new ethanolamine — N-Ethyl Ethanolamine — has been announced as available in commercial quantities by its makers, Carbide and Carbon Chemicals Company, Divi-

(*Turn to Page 121*)



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PROGRESSIVE CHEMISTRY FOR OVER A CENTURY

The Listening Post

Materials for Heat Treatment of Peas & Beans

This department, which reviews current plant disease and insect control problems, is a regular monthly feature of AGRICULTURAL CHEMICALS. The comments on current plant disease problems are based on observations submitted by collaborators of the Plant Disease Survey Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture, Beltsville, Md.

By Paul R. Miller

HOT water is suitable for treatment of tomato, carrot, and cabbage seed for the control of seed-borne pathogens. It is undesirable as a medium for treating peas and beans, causing the seed-coats to wrinkle and slip and thus making them unfit for planting. R. D. Watson, Lewis Coltrin, and Ronald Robinson, of the Idaho Agricultural Experiment Station, report tests of a number of different materials in the search for one suitable for heat treatment of Thomas Laxton peas, Tendergreen beans, and Clarke bush lima beans. Considering first the effect of the materials with heat on the seed, they state that further research will be necessary to evaluate the practical use of the materials and heat on the control of seed-borne pathogens.

The materials selected as possible treating agents were: carbon tetrachloride, mineral oil, Shell cleaner, Prestone (ethylene glycol), motor oil (S.A.E. 10), roccal, methyl alcohol, kerosene, xylol, lactic acid solutions, toluene, acetone, glycerine, cedar oil, aniline oil, olive oil, sodium chloride solutions, and cotton seed oil.

The first test was soaking to determine the toxicity of the materials. As a rule, the oils were toxic to the seed and were removed from the seed surface in the heat treatment that followed. The desired heat treatments were conducted in a constant temperature bath. Seeds were put into the bath at various time intervals and all were removed at the end of the treatment. This was done to minimize the usual initial drop in temperature of the bath when a large quantity of seed enters the bath at one time.

Some materials, such as lactic acid, methyl alcohol, and sodium chloride solutions were eliminated because they caused the seeds to swell and the coats to slip. Methyl alcohol, toluene, and acetone were excluded from further tests because of the fire hazard and because they were less effective than the oils or carbon tetrachloride. Most of the oils,—cedar, aniline, olive, and cotton seed—were dropped because they acted similarly to less expensive motor oil. Roccal was excluded because it killed the seeds. In the further exploratory tests, carbon tetrachloride, motor oil (S.A.E. 10), fuel oil, and mineral oil were used. Mineral oil was later excluded since it was no more effective than motor oil and was more costly.

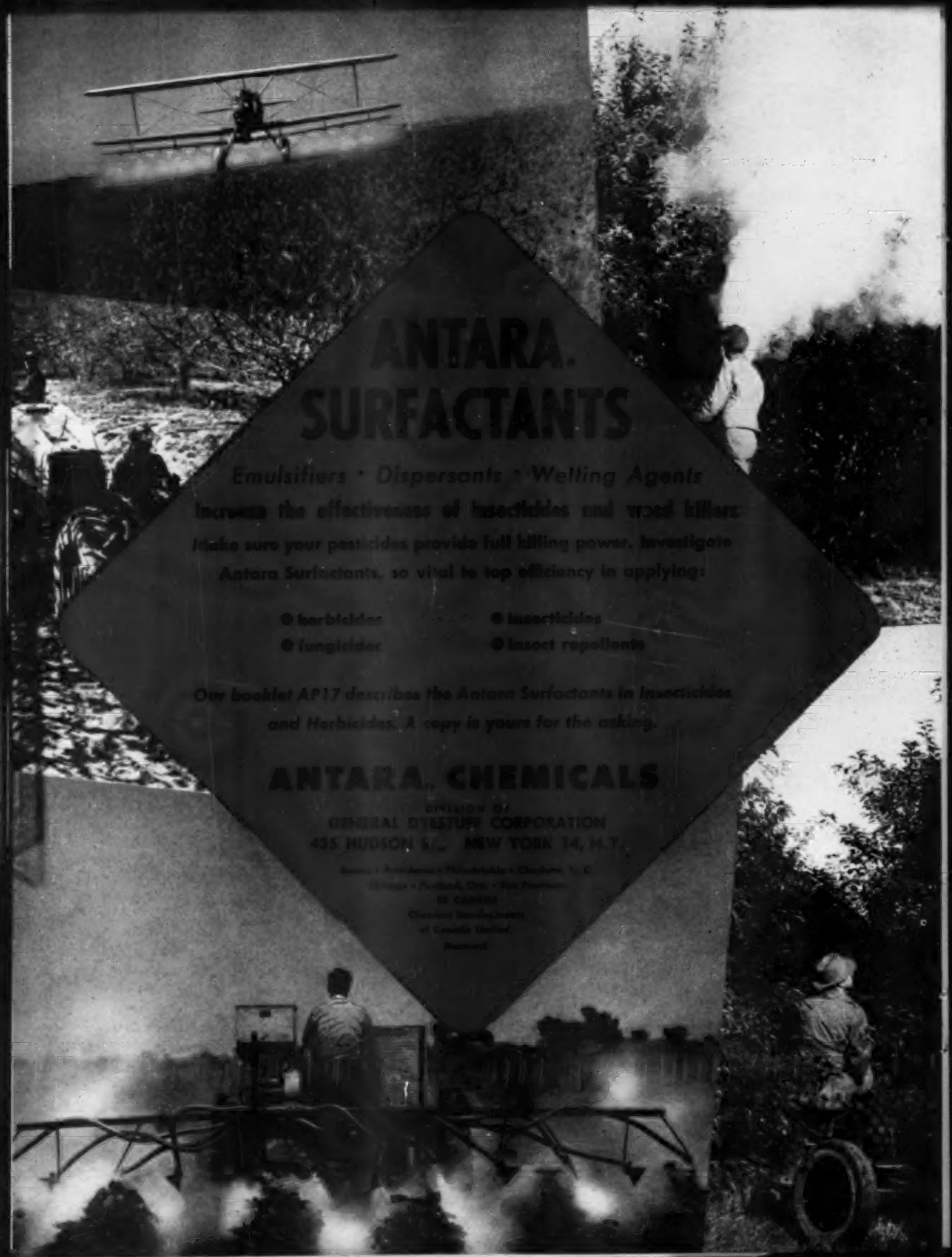
Further experiments were conducted to determine the thermal death point of Thomas Laxton peas, Tendergreen beans, and Clarke bush lima beans when exposed at different temperatures in water, carbon tetrachloride, fuel oil, and motor oil. Lima beans were more resistant to hot water than were beans and peas, but germination was severely reduced by longer exposures and higher temperatures. Of the materials tested, fuel oil reduced germination of lima beans most. Motor oil acted more like carbon tetrachloride than did the other materials, but germination of seeds treated in motor oil was reduced, owing to the penetration of the oils, so much that motor oil was excluded from final tests (Tables 1 and 2). In other experiments, peas, beans, and lima beans were able to withstand treatment in carbon tetrachloride for a considerable time without serious reduction in germination (Table 3).

Carbon tetrachloride possesses several properties that make it the most desirable of the treating materials tested. Seeds were able to survive long periods of exposure to heat in carbon tetrachloride without seriously reducing their viability. Carbon tetrachloride is not toxic and evaporates readily from the seed, leaving no harmful residues. The seed coats do not slip after prolonged immersions. It is absorbed but little by the seed. The boiling point is around 76.8°C (167°F). At this temperature, carbon tetrachloride becomes a constantly boiling liquid at a given pressure, which would eliminate intricate temperature control apparatus for maintaining constant temperatures. Carbon tetrachloride does not present a fire hazard. All of these qualities make it an ideal substance to be used as a heat-treating material.

The specific heat of water is five times greater than that of carbon tetrachloride. This fact does not account, however, for ability of the seed to survive extended exposures in carbon tetrachloride, whereas they are killed in a relatively short time in hot water. Heat is not transferred as rapidly from carbon tetrachloride as from water to the seed, although the difference is slight. In a relatively short time seeds will be as hot in carbon tetrachloride as in water.

Summary: Of the materials tested, carbon tetrachloride appeared to be the most suitable treating medium for Tendergreen beans, Thomas Laxton peas, and Clarke bush lima beans.

Beans, peas, and lima beans were able to survive extended exposures in hot carbon tetrachloride, whereas they were killed in relatively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short time when exposed in water of the same temperature.

Lima beans were more resistant to hot water than were the peas or beans tested. Hot carbon tetrachloride should be of value in destroying seed-borne organisms in peas and beans.

Combined Seed Treatment and Seed Inoculation Studies With Soybeans

TO determine the effect of combining seed inoculation with root nodule bacteria and fungicidal seed treatments for soybeans, T. J. Nugent, S. B. Fenne, and W. C. White, of the Virginia Polytechnic Institute, made a field test at Norfolk, Virginia in 1950. A bulk lot of Ogden soybean seed was divided into four parts, two parts of which were treated with Arasan (3 ounces per 100 lbs.), and two parts of which were left untreated. On May 9 one lot of each of

Table 1. Germination of Tendergreen beans after exposures of 60°C, 70°C, 80°C and 90°C in carbon tetrachloride, motor oil, fuel oil and water.*

	Percent of seed germinated after treatment														
	60°C				70°C				76.8°**	80°C			90°C		
Time of treatment	CCl_4	Motor oil	Fuel oil	H_2O	CCl_4	Motor oil	Fuel oil	H_2O	CCl_4	Motor oil	Fuel oil	H_2O	Motor oil	Fuel oil	H_2O
O-Check	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
10 min.	88	96	68	88	88	96	92	84	68	80	60	12	40	40	0
20 min.	92	96	68	84	100	88	52	12	76	80	24	0	0	0	0
30 min.	100	92	76	44	96	80	84	0	88	52	16	0	0	0	0
40 min.	100	100	72	4	100	92	80	0	84	40	16	0	0	0	0
50 min.	92	92	68	0	84	96	84	0	76	52	0	0	0	0	0
60 min.	96	84	64	0	80	84	56	0	80	12	0	0	0	0	0

*(Peas and beans reacted very similarly and only a representative bean table is reproduced).
**Carbon tetrachloride boils at 76.8°C

Table 2. Germination of lima beans after exposures of 60°C, 70°C, 80°C and 90°C in carbon tetrachloride, motor oil, fuel oil and water.*

	Percent of seed germinated after treatment														
	60°C				70°C				76.8°**	80°C			90°C		
Time of treatment	CCl_4	Motor oil	Fuel oil	H_2O	CCl_4	Motor oil	Fuel oil	H_2O	CCl_4	Motor oil	Fuel oil	H_2O	Motor oil	Fuel oil	H_2O
O-Check	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
10 min.	64	72	36	88	68	92	68	100	68	64	12	68	12	4	0
20 min.	72	92	24	100	60	56	44	84	84	16	0	12	4	4	0
30 min.	60	64	60	100	100	80	16	76	84	0	0	0	0	0	0
40 min.	72	52	44	96	72	76	24	60	84	0	0	0	0	0	0
50 min.	84	72	20	80	68	60	44	8	84	0	0	0	0	0	0
60 min.	56	56	24	60	56	64	28	0	72	0	0	0	0	0	0

*(Peas and beans reacted very similarly and only a representative bean table is reproduced).
**Carbon tetrachloride boils at 76.8°C

Table 3. Germination of Superlaska peas, Tendergreen beans, and Lima beans after exposures of 65°C, and 75°C in water and carbon tetrachloride.

	Percent* of seeds germinated after treatment											
	65°C						75°C					
	Superlaska peas		Tendergreen beans		Lima beans		Superlaska peas		Tendergreen beans		Lima beans	
Time of treatment	H_2O	CCl_4	H_2O	CCl_4	H_2O	CCl_4	H_2O	CCl_4	H_2O	CCl_4	H_2O	CCl_4
O-Check	100	100	98	98	84	84	100	100	100	100	84	84
10 min.	90	98	88	92	74	66	94	96	80	90	92	84
20 min.	70	86	80	92	78	98	30	98	20	94	88	88
30 min.	24	98	62	90	74	90	10	100	2	96	82	88
40 min.	18	96	48	84	90	86	0	100	0	96	46	92
50 min.	12	98	30	86	80	80	0	100	0	98	30	94
60 min.	0	82	12	96	74	82	0	98	0	86	6	90

*Percentage based on average of two replicates of 25 seeds each.

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the treated and untreated seed was inoculated with Nitragin and all treatments planted immediately afterwards. The soybeans were planted three inches apart in rows 3½ feet apart. Each treatment was replicated (100 seed per replicate) four times in a Latin square arrangement. This Latin square was duplicated and the

(*Turn to Page 123*)

Insect Activity Begins for New Season

This column, reviewing current insect control programs, is a regular feature of AGRICULTURAL CHEMICALS. Mr. Dorward is connected with the department of Insect Pest Survey and Information, Agricultural Research Administration, Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, Washington. His observations are based on latest reports from collaborators in the U.S.D.A.'s pest surveys throughout the United States.

By Kelvin Dorward

ALTHOUGH vegetable insect activity in general was rather slow during early March, some damage was reported. Leaf miners were present in moderate to heavy numbers on beans in the Lake Worth section of Florida, on tomatoes in Dade County ranging from numerous to serious, except where controlled by insecticides, and were heavily infesting cabbage in the Fort Myers - Immokalee section. The false chinch bug was seriously abundant on mustard in the Baton Rouge section of Louisiana. Vegetable weevils were reported to be damaging spinach moderately in South Carolina and were appearing in fair numbers on various truck crops in Jones County, Georgia. In Alabama, this insect was causing damage to crucifers. Cucumber beetles were causing serious damage to spinach in South Carolina. Aphids were reported from Virginia, South Carolina and Florida but generally in moderate numbers.

Army Cut Worms Threaten

THE season of 1951 produced the worst army cut worm outbreak in history on wheat and other small grains in Kansas, Oklahoma and Texas.

During February, 1952, army cut worms appeared in Texas, Oklahoma, and Kansas in such numbers that an outbreak appeared possible. Although army cut worms were reported from the majority of the Texas pandhandle counties, the heaviest infestation appeared to be in the Wichita Falls, Quanah, Childress area. A survey conducted in Oklahoma showed army cut worms to be present in all western counties surveyed. The heaviest infestations were found in Tillman, Kiowa, Greer, Blaine, Major, Dewey, and Woodward counties. Fairly heavy infestations were found along the southern border of Kansas in the counties of Mead, Comanche, Barber, and Harper. Control measures for the army cut worm have been applied in parts of Texas and Oklahoma.

A Summary of 1951 Cotton Insect Conditions

THE winter of 1950-51 was severe enough to reduce materially the population of boll weevils hibernating from the previous season. However, even with this decrease in surviving weevils, there were sufficient numbers to cause damage in most areas where the insect occurred in 1950. The wide use of insecticides early in the 1951 season, together with hot, dry weather during July and August, prevented boll weevil damage to cotton from being as serious as in 1949 and 1950.

The cotton leaf worm caused little or no damage to the cotton crop in 1951. The first leaf worm was found July 17, in Cameron County, Texas. By September 1, infestation had been reported from three additional counties in Texas and one county in Florida. With the exception of a few fields in south Texas, no infestation developed that required insecticidal control. Many insecticide formulations used in the control of other cotton insects are giving satisfactory control of this insect.

Other lepidopterous larvae abundant on cotton during 1951, included the tobacco budworm, the yellow-striped army worm, the fall army worm, the beet army worm and the garden webworm. The first three named not only feed upon the foliage of cotton, but also cause damage to the bolls very similar to that caused by the bollworm *(Heliothis armigera (Hbn))*.

Cotton fleahopper infestations were unusually light throughout the growing season of 1951 in 12 major cotton growing states. The heavy insecticide schedule maintained on cotton apparently helped to hold the cotton fleahopper in check in most areas.

Cotton aphids were not as important as they were from 1920 to 1940 because aphid damage to cotton has been greatly reduced by the general substitution of organic insecticides for calcium arsenate.

Although several species of spider mites are known to attack cotton, the two-spotted spider mite and a recently described species, *Septanychus texazana* McG, are the two believed to be of the greatest importance as cotton pests. The spider mites caused serious damage to cotton in 1951 from the Atlantic to the Pacific. Since spider mites are associated with drouth conditions and in many localities the summer of 1951 was the driest on record, it is extremely difficult to determine the exact damage caused by each of the two factors.★★

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Forest Insect Survey Out

A summary of the more important forest insects of 1951 has been published by the U. S. Department of Agriculture, Division of Forest Insect Investigations of the Bureau of Entomology and Plant Quarantine. Designated as Special Report No. 4, the 20-page summary is based on information from surveys and reports from nine field stations.

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Technical Briefs

Report Corn Borer Studies

The old method of watching for the first egg masses to begin hatching as the signal for first application of insecticides for corn borer control has been succeeded by a new guide, first appearance of holes in the leaves, H. C. Chiang, research fellow in entomology at University of Minnesota, reported at the University's 50th annual Farm and Home Week.

Leaf injury is of course caused by feeding of the young larvae and is the earliest sign of the presence of active larvae in corn plants. It becomes noticeable on the leaves four to six days after it is made and can be observed easily. When these holes can be seen on the leaves, that's the time to spray, Mr. Chiang suggested.

He said Minnesota was among the first to study leaf injury as an index for timing insecticide applications and that, although the method has not been developed to a perfect stage, results indicate advantages over methods now used.

Up to the present, the only recommended method for timing has been to apply insecticides 10 to 12 days after the first borer eggs have hatched. This method is adequate if checked accurately, but, since the first hatching may be missed by several days, such an error may reduce the efficiency of the insecticide.

Using the first hatching of eggs as an index also fails to take into consideration the natural mortality rate of the young borers from weather and the fact that cool weather may slow up the hatching. Thus applicators may be led into putting on insecticide when it will do little good.

•

Control of Panama Disease

A water control for "Panama Disease," a fungus infection which attacks the roots of banana plants, has been discovered by the Tela Railroad Company, a Honduran affiliate of the United Fruit Company. The procedure is to flood the infected land and seal off the soil, thus "drowning" the infection. Flooding for one to three years is reported successful in ridding the ground of the fungus.

•

Fungicide Particle Size

This is not a new problem, nevertheless it seems that the important factor of small particle size of fungicides has not received enough attention everywhere.

Scientists, who are in charge of testing the preparations brought on the market, must be aware of this.

The use of low-volume sprayers has placed this problem before us again.

From literature several important articles are mentioned dealing with the effect of particle size on the effectiveness of fungicides, more especially of sulphur- and copper-preparations and of the quinones.

The unanimous conclusion of all the authors is, the fungicides with finer particles have a higher toxicity, a better coverage of the plant treated, and an increased tenacity.

In agricultural and horticultural practice, this means a better result with a lower concentration of toxic substance.

Recent experience in the Netherlands fully confirms these literature-data, more especially for the wettable sulphurs and for copper-preparations.

It cannot be said that this influence of particle size will be found in all types of fungicides. More research must be done in this field of practical science. It is still to be seen, if there are certain limits of particle size of fungicides, below which the improvement comes to an end.

Improvement of the physical qualities of the preparations will lead to a more economic use of the fungicidal materials and is a biological necessity because we must not treat our crops with a higher quantity of these toxic substances, than is absolutely needed for a good control of the diseases.

———Summary of article, "The Role of the Particle Sizes of Fungicides" by K. Hartsuijker, Ghent, Belgium.

•

European Sawfly in N. Y.

The European apple sawfly (*Hopolocampa testudinea*) has been reported from New York state for the past season or two. While the infestation is not currently of serious proportions, entomologists and fruit growers alike naturally fear a spread of the pest. On the basis of but one year's experimental results from control work, the New York State College of Agriculture recommends parathion as the number one control material, in the amount of two lbs. of 15% wettable powder per 100 gallons of spray, applied at petal fall. Alternate control materials are benzene hexachloride, 2 lbs. of 10% gamma material per 100 gallons, at petal fall, and nicotine sulfate, 1 quart per 100 gallons, at petal fall and seven days later.

•

Fertilizer Use Studied

Soils in the western area are highly variable. Many of these soils contain no free lime and yet are not acid in reaction. The calcareous soils vary — lime content of from fifty percent to only minute amounts. Not only do the soils vary in the amount of lime contained but also in the form or activity of that lime. Most contain a large amount of total phosphorus.

Phosphate fertilizer usage is relatively new in the area and research on phosphate materials inadequate. In a review made about 3 years ago, it was shown that very little was known about either placement of phosphate or the relative value of the different materials for calcareous soils. We have been forced to rely on work done on acid soils for our information which we now know is not entirely satisfactory for our conditions.

To many it has appeared that it would be easy to solve the problems with a few field trials. This has not been so. Often no response to phos-

Every year—yes, almost every month—the farm picture changes, as scientific research comes up with better methods and new agricultural chemicals. The last few years, in particular, have been a period of rapid development—and there is reason to believe that this will be the case for many years to come.

Dow has played an important part in advancing the role of agricultural chemicals. Not in just the last few years, but over nearly half a century, Dow has developed, tested and marketed many important chemical aids to efficient farming. Agricultural leaders have learned to rely on the "know-how" that is responsible for the uniformly high quality of Dow products.

At Dow, a large technical staff is engaged in developing new farm chemicals *and* in thoroughly testing every product before it is offered to growers. This means testing in Dow laboratories *plus* actual testing on Dow experimental farms and in cooperation with private growers and federal, state and local experiment stations. The Dow Chemical Company is anxious to work with persons responsible for recommending agricultural chemicals. Dow sales and technical men are available for consultation. Your inquiries are invited. Write to Dow—Dept. AG-52F-190.

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phate was found and no evaluation could be made of either placement or materials. Even where a response was obtained in the form of increased crop yields, the results were variable and the evidence conflicting.

During the last three years, much valuable information has been obtained. This has been due largely to: (1) Research funds made available by the fertilizer industry (2) The close cooperation of workers through the research committees (3) Incorporation of radioactive phosphorus into the different fertilizer materials.

With the tagged fertilizer, it is possible to measure the amount of phosphorus in the plant that comes from the added fertilizer. This gives a measure of the relative effectiveness of the different materials or the different placements whichever is being studied.

The data from placement tests in several states represent examples of the work done. The general tentative conclusions are as follows:

1. Neither band placement, broadcasting or incorporation with the plow layer of the soil is superior.

2. The superiority of one method over another depends on many variables such as crops, moisture conditions, fertility status of the soils, and the time of application.

3. Fertilizer mixed with the soil is not fixed to the extent that it is unavailable to the plants.

4. Mixing of the fertilizer with the soil, such as is done by broadcasting the fertilizer and plowing or disking the land, is particularly effective on very deficient soils during early plant growth. The early stimulation does not always persist until the time of harvest.

From comparisons made as to the relative availability of different materials, the following conclusions seem justified: 1. That superphosphate - double superphosphate - phosphoric acid- ammonium phosphate (11-48-0) > calcium meta > dicalcium > tricalcium phosphate. 2. The availability of calcium meta phosphate increases as the material is reduced in particle size. 3. Nitric phosphate appears (in a limited test) to be equally available to the watersoluble fertilizers. 4. Rhenania phosphate (heated soda ash and rock phosphate) when finely ground, is available to the plants. 5. The order of relative availability is not changed for different crops at least for the limited number of crops tested. 6. One material such as phosphoric acid which is applied in the irrigation water, may have an advantage over other materials for specific conditions.

The conclusions drawn from placement trials and comparisons of materials are for one season only. Residual values have not been evaluated because the half-life of the radioactive fertilizer is such that the material is useful for only one season.

Tests are under way in which the effect of moisture on the availability of phosphorus is being evaluated. A project has been approved in which the effect of ammoniation of superphosphate (single and double) on the availability of the phosphorus is being determined. Also being studied are fundamental reactions of phosphorus materials and lime.

With the completion of these programs will come a much better understanding of the phosphate problems on calcareous soils of the west.

"The Influence of Kind of Fertilizer Material and Placement on Utilization of Fertilizer Phosphorus by Crops on Calcareous Soils", by H. B. Peterson, Professor of Soils, Utah Agricultural Experiment Station, Logan, in reent report on radioisotope investigations for 1951, Beltsville, Md.

•

2,4-D in Corn

Rates of 2,4-D exceeding ½ pound of acid per acre are hazardous to use to control weeds in corn. Dosages of from ⅓ to ½ pound produced satisfactory kill of most broadleaf weeds with only slight injury to the corn. Brittleness, some lodging and malformation of brace roots developed at these rates but did not affect yields. Small corn (3to 6 inches high) is apparently more tolerant to 2,4-D than taller corn, since less material is absorbed by the lesser leaf area. Another factor affecting tolerance of corn to 2,4-D is its growth rate. Spraying when conditions are favorable for plant growth is conducive to injury. Injury to corn is greater with ester formulations than with amine salts at equal rates.

Pre-emergence treatments in corn using 2 pounds of 2,4-D acid per acre (ester formulation) controlled most weeds and did not injure the corn on Brookston silt loam. Dichloral urea, sodium 2,4- dichlorophenoxy ethyl sulfate, and 3,6-endoxohexahydrothalic acid did not compare favorably with 2,4-D.

Post-emergence sprays of 2,4-D applied at rates of ⅛ pound or more of acid per acre injured soybeans. Enough 2,4-D applied to destroy weeds as pre-emergence applications also injured the soybeans. Generally the chemicals caused dwarfing, twisting of stems, delayed maturity and reduced the stand. Rates of ¼ pound caused a corky or rough surface of the stems, a sub-epidermal proliferation.

Dinitros (4,6-dinitro-o-cresol —a sodium salt) gave some promise as a chemical to control weeds in soybeans when applied at rates of 6 pounds per acre. Dinitros in fuel oil, (5%) when applied at rates of 4 to 6 gallons per acre are promising for defoliating weeds in soybeans and thereby facilitate combining. Herbicide 2,4,5-T (2,4,5-trichlorophenoxyacetic acid) is more effective than 2,-4-D or a combination of the two for the eradication of horse nettle (*Solanum carolininse*). Best results were obtained when applied in the early bloom stage of growth. Canada thistle (*Cirsium arvense*) is more effectively killed by 2,4-D than by 2,4,5-T.

Spring application of 2,4-D, 2,4,5-T and 3,6-endoxohexahydrophthalate at rates of from ¾ to 3 pounds of acid per acre failed to give satisfactory control of wild garlic (*Allium vineale*). The heavy rates caused come epinasty, but did not prevent the production of aerial bulbils. Top growth was controlled about 70% with 2,4,5-T applied in oil. All areas treated during the spring had considerable regrowth of garlic in October of the same year.

TCA (sodium trichloro acetate) is an effective eradicant of John-

(*Turn to Page* 129)

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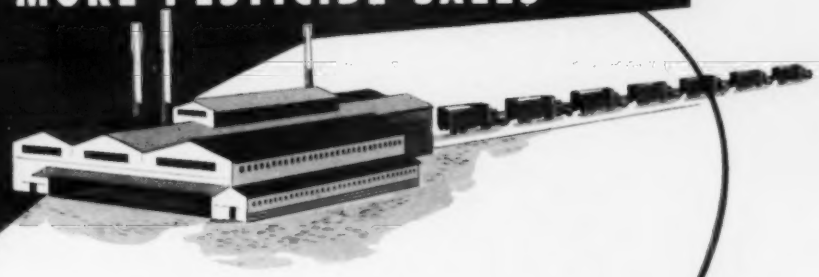

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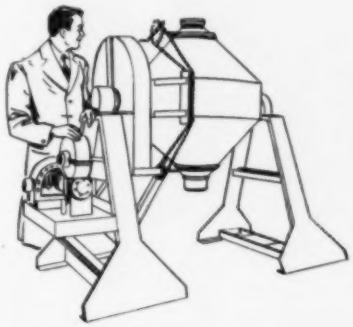

For impregnating liquid toxicants—milling DDT, BHC, or other organics—conditioning blended dusts—the total demand for DILUEX has multiplied during these years. Production facilities have been greatly enlarged to keep pace. Inquiries and orders will be given prompt attention.

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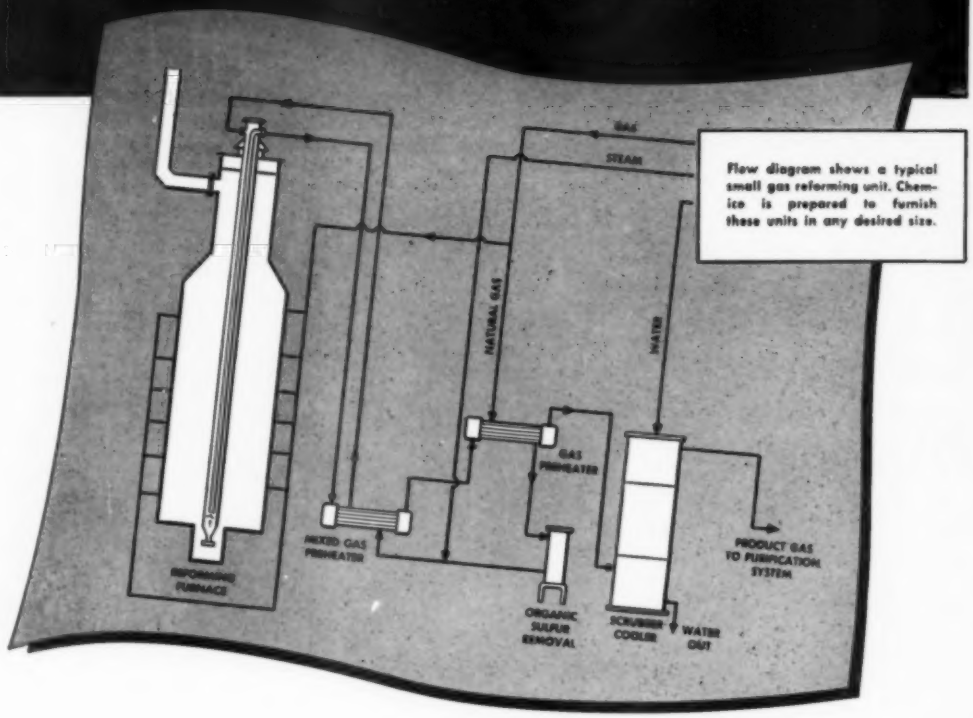

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Chlordane also is very effective in the control of other pests to tobacco growers, including Mole Crickets, Seed Corn Maggots, Tobacco Webworms, Green June Beetles and various species of Cutworms.

We shall be happy to send you our new and informative booklet "Chlordane In Tobacco Transplant Water Controls Wireworms", free upon request. May we suggest that, for complete information upon the use of chlordane in your transplant water for your specific area, you contact your insecticide dealer, County Agricultural Agent, or State and Federal authorities?

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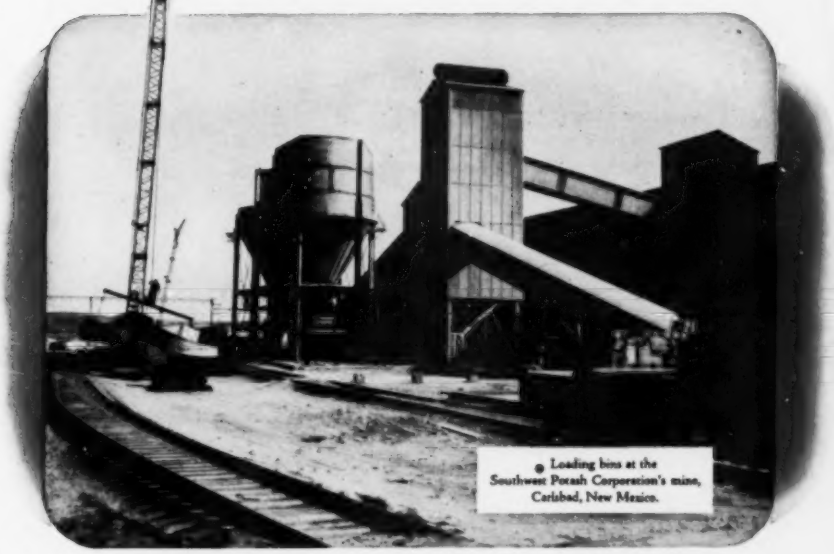

Loading bins at the Southwest Potash Corporation's mine, Carlsbad, New Mexico.

A new dependable source of Potash

THE Southwest Potash Corporation announces that its mine and refinery near Carlsbad, New Mexico, will soon be in operation.

Installation and erection of the most modern mining equipment and refinery are well under way. Production in substantial volume of HIGH-K Brand* Muriate of Potash (60% K_2O minimum) is scheduled to begin about August of this year.

Southwest Potash will provide a dependable source of HIGH-K Brand Potash for agriculture and industry. Your inquiries are invited.

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INDUSTRY NEWS

Geigy Advances White

Geigy Company, Inc., Insecticide Division, has announced the appointment of C. L. White as regional manager of the Southwest Territory. Mr. White held the post of southeast sales manager for three years.

C. L. WHITE

Before joining Geigy, Mr. White was vice-president of White-Peele Co. of Clayton, N. C. He holds a B.S. degree in civil engineering from the University of North Carolina, and is a resident of Southern Pines. He will be located at the Insecticide Division's Southeast headquarters in Aberdeen, N. C.

Mr. White's new duties will place him in charge of sales from Virginia to Florida and from Mississippi to Kentucky. In addition to the formulating plant in Aberdeen, Geigy has other plants in the territory at Leland, Miss. and Orlando, Fla. Geigy formulates dusts and liquids for cotton and tobacco pests as well as products for virtually every other crop grown in the Southeast.

•

DuPont Toxicoloical Lab

Plans for construction of a $2,000,000 Haskell Laboratory of Industrial Toxicology near Newark, Delaware were recently announced by E. I. DuPont de Nemours and Co., Wilmington. The new plant will be a single story brick structure and will provide 33,000 square feet of space. The entire building will be air conditioned and construction is expected to take about a year.

Work of the Haskell Laboratory is devoted to research on potential industrial hazards associated with products and processes of DuPont's manufacturing departments. The new plant will be along the same lines as the Stine Laboratory for animal medicine and nutrition already being built near Newark. The entire staff of Haskell Laboratory will move to the new building upon completion.

•

Kolker Advances Two

Kolker Chemical Works, Newark, N. J., recently made two advances in their sales staff, according to an announcement by J. G. Brunton, vice-president in charge of sales. L. J. Polite, Jr., formerly chlorinated solvents supervisor for Diamond Alkali, has been appointed to the sales staff of Kolker's agricultural chemicals division. Stanley B. Honour, formerly with the export department of Sherwin Williams Co., has been appointed to supervise export sales. The changes are a part of the present expansion program at Newark and Houston.

•

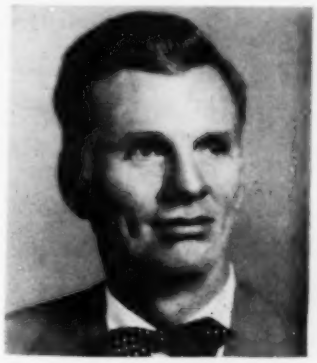
Krilium Demand Grows

Monsanto Chemical Co., St. Louis, Mo., has been swamped with requests for "Krilium," new soil conditioner produced by the company, an officer of the firm has announced. He said that requests have come from every state in the union and from forty foreign countries to such an extent that he said it was doubtful that all such requests could be met within the next five years.

Dr. Lloyd V. Sherwood, research chief, said that the company's present output of krilium is going into research projects and that it will not be on the market in substantial quantities until 1953.

W. R. Allstetter to NFA

The National Fertilizer Association, Washington, D.C., through J. E. Totman, chairman of the Board of Directors, has announced the appointment of W. R. Allstetter as vice-president.



W. R. ALLSTETTER

Mr. Allstetter was formerly with the U. S. Department of Agriculture where he was serving as deputy director of the Office of Materials and Facilities in Charge of Fertilizer and Agricultural Chemical Programs. Between April 1 and April 15, he was to serve as adviser to Gus F. Geissler, Administrator of the Department's Production and Marketing Administration.

The new vice-president was graduated from Swathmore College in 1932 with honors in chemistry and physics and later attended Yale Law School for a year.

For a number of years, he has been associated closely with the fertilizer industry, first through his interest in a fertilizer producing company and more recently through his work with the Fertilizer Industry Advisory Committee.

His primary responsibility at NFA will be to help develop programs of mutual interest between industry and government agencies.

Ethyl Advances Dr. Smith

Dr. Charles L. Smith has been promoted by Ethyl Corporation to the newly-created post of associate director of product development in

DR. C. L. SMITH

charge of agricultural chemicals. He will assist William T. Hack, director of product development, according to an announcement by B. Bynum Turner, vice-president in charge of research and engineering.

Dr. Smith, who has been associated with Ethyl since 1949, has been active in the Corporation's technical work in the agricultural chemicals field. Prior to joining Ethyl, he was technical advisor to the National Agricultural Chemicals Association. He has also served as research entomologist at Rutgers University, manager of the Doggett-Pfeil Company, and analytical chemist for Interstate Chemical Manufacturing Company.

A native of Trumansburg, N. Y., Dr. Smith received his B. Sc., M. Sc., and Ph. D. degrees from Rutgers University. He is a member of the American Association of Economic Entomologists, the American Phytopathological Society, the Chemical Market Research Association, and the Chemists Club.

•

NFA Convention Planned

According to Wm. E. Chace, information chief for the National Fertilizer Association, Washington, plans for the June 16-18 meeting of the Association at the Greenbrier Hotel, White Sulphur Springs, W. Va. are well under way. No specific announcements have been made, but Association officials state that the program will include speakers representing the manufacturing industry, the Federal government and other state aencies at the three-day program.

Arrangements are being made for the annual tournaments including golf, horseshoe pitching, tennis, etc.

•

Webb Named Vice-Pres.

Election of Mangum Webb as vice-president of Chemical Construction Corporation was announced March 13. He joined the firm in 1914 when it was founded, served as Far Eastern Representative in Shanghai, China from 1935 to 1936, as procurement director during World War II,

MANGUM WEBB

then became assistant sales manager and director of engineering of the Ion Exchange Department of American Cyanamid Company, the parent firm.

Mr. Webb has been sales manager of Chemical Construction since 1949. A native of Charlotte, North Carolina, he received his education at North Carolina State College.

•

Harris to Prentiss Drug

Dr. C. S. Harris has been appointed entomologist for the Insecticide Division of Prentiss Drug & Chemical Co., it was announced recently by Friar Thompson, vice-president of the company.

Dr. Harris, a graduate of Ohio State University, spent many years with the Shell Oil and associated companies as entomologist and agricultural specialist, planning and directing a program of research, product and application development, and market development on pesticides manufactured and marketed by Shell east of the Rockies.

Dr. Harris' background experience also includes work with the U. S. Department of Agriculture, Missouri and Ohio Agricultural Experiment Stations, and a professorship in biology with the Rio Grande College.

MEETINGS

American Chemical Society. Pesticides Subdivision. Milwaukee, Wis., March 30-April 3.

National Agricultural Chemicals Association. Spring Meeting. San Francisco, Calif., Fairmont Hotel. April 6-9.

Fertilizer Safety Meeting of North Carolina State Safety Conference. Asheville, N. C., May 6.

Fertilizer Safety Section of the Virginia State Safety Conference. Richmond, Va., May 16.

Chemical Specialties Manufacturers Association. Copley-Plaza Hotel. Boston, Mass., June 8-10.

Conference on Use of Isotopes in Plant and Animal Research. Kansas Agricultural Experiment Station. Manhattan. June 12-14.

National Fertilizer Association, Greenbrier Hotel, White Sulphur Springs, W. Va., June 16-18.

Meeting of Advisory Committee of Fertilizer Section of National Safety Council, Greenbrier Hotel, White Sulphur Springs, W. Va., June 19.

American Plant Food Council, Homestead Hotel, Hot Springs, Va., June 19-22.

Pacific Branch, A.A.E.E., Mar Monte Hotel, Santa Barbara, California, June 24-26.

Soil Improvement Committee, Pacific Northwest Plant Food Association, Pocatello, Idaho, July 9, 10 & 11.

Sixth International Grasslands Congress, Penn State College, State College, Pa., August 17-23.

American Phytopathological Society, Cornell University, Ithaca, N. Y., September 9-12.

National Pest Control Association, Rice Hotel, Houston, Texas, October 20-22.

Meeting of Fertilizer Section of National Safety Congress, Chicago, Ill., October 22 & 23.

Sixth Annual Beltwide Cotton Mechanization Conference, Bakersfield, California, Oct. 22-24.

California Fertilizer Association, Desert Inn, Palm Springs, Calif., Nov. 10-12.

Joint meeting, North Central Weed Control Conference and Western Canadian Weed Conference, Royal Alexandra Hotel, Winnipeg, Canada, December 8, 1952.

Va. Safety Conf. for May

A state-wide safety conference is scheduled for the fertilizer manufacturers of Virginia at Richmond, May 16, 1952, according to William C. Richardson, assistant manager of the fertilizer department, Southern States Cooperative, Richmond, and chairman of the meeting.

John E. Smith, Spencer Chemical Co., Kansas City, Mo., vice-chairman of the Fertilizer Section of the National Safety Council, will speak on "Fertilizer Safety on a National Basis"; J. D. Robins, superintendent, Virginia-Carolina Chemical Corp. plant at Wilmington, N.C., will discuss "The Problem of Overhangs in the Storage of Bulk Materials"; Park Newton, Jr., Applied Engineering Co., Orangeburg, S. C., will talk to the group on "Safety Precautions in the Storage and Use of Anhydrous Ammonia"; and Tom Clarke, editor of the National Safety Council's *Fertilizer Safety News*, Ithaca, N. Y., will address the assembly.

"The Acidulation of Phosphate Rock" will be discussed by S. F. Alexander, Swift & Co., Wilmington, N. C.; and E. O. Burroughs, Jr., manager, Insurance Dept., F. S. Royster Guano Co., Norfolk, Va., will point out the necessity for good housekeeping in fertilizer plants.

•

New Okla. Fertilizer Plant

Consumers Cooperative Association recently opened their latest superphosphate plant at Muskogee, Oklahoma. The plant, started on September 24th, 1951, was completed in January and the first trial run took place on January 11. The plant is now in steady operation. It has an annual capacity of 25,000 tons and storage space for 4,000 tons. Plant and equipment represent an investment of almost $200,000 in the co-op fertilizer program.

•

Savannah Firm Names Two

W. W. Harley and Allen D. Brent have been made vice-presidents of the Southern Fertilizer and Chemical Co., Savannah, Ga., according to an announcement by the company recently.

Houston Pasture Conference Held

In charge of arrangements for the Houston pasture tour, were the three men shown above. They are (L to R): George Roesner, Radio Farm Director of station KTRH, Houston, master of ceremonies; Dr. Arthur Smith, chief agronomist, Mathieson Chemical Co., Baltimore, Md.; and Jerry Ehlert, chairman of the meeting.

The third annual Houston Area Pasture Conference was held in Houston, Texas, recently, with some 500 Gulf Coast farmers and ranchers attending. Speakers included Dr. Arthur Smith, chief agronomist for Mathieson Chemical Co., A. W. Crain and Dr. J. S. Williams from Texas A & M, J. C. Smith from the Angleton Experiment Station and W. A. Whitehill, of PMA. In drawing for attendance prizes some 4,000 lbs. of fertilizer and 300 lbs. of pasture seed were given away by Houston seed and fertilizer concerns.

Hercules Elects to Board

Paul Mayfield, general manager of the Naval Stores Department and Elmer F. Hinner, general manager of the Virginia Cellulose Dept., Hercules Powder Co., Wilmington, Del., were named directors of the company at the firm's annual meeting March 18.

Mr. Mayfield is well known in the pesticide trade, and is currently vice-president of the National Agricultural Chemicals Association. He is a graduate of Indiana University and has been associated with Hercules for 27 years.

Mr. Hinner, a graduate of Pennsylvania State College, joined Hercules in 1927.

All other members of the board were re-elected at the March meeting. They are: Leavitt N. Bent, Wyly M. Billing, Russell H. Dunham, Wm. R. Ellis, Albert E. Forster, John J. B. Fulenwider, Charles A. Higgins, John B. Johnson, Francis J. Kennerley, Mahlon G. Milliken, Edward B. Morrow, Anson B. Nixon, Reginald Rockwell and Philip B. Stull.

•

New Sulfur Production

Freeport Sulphur Co. has announced the expenditure of approximately $20 million on new projects to increase the sulfur supply. In a recent report to stockholders, the firm said that activities of 1951 were of utmost importance to the company. Developments included the acquistion of new reserves in sulfur in salt-dome deposits and in other forms; the start of a new brimstone mine in Louisiana; and production of 1,560,000 long tons of sulfur for a new record.

The report said that a third new mining development is being undertaken at Nash Dome, about 35 miles from Houston, Tex.

new blossoms on an old plant

This is good news in agriculture and in industry. Increased availability of vital plant nutrients in the form of soluble inorganic salts for fertilizer solutions can mean new products and new markets for fertilizer manufacturers.

New emphasis is being placed upon WATER-SOLUBLE FERTILIZERS. Growers and manufacturers are developing new methods . . . new applications of high-analysis soluble plant foods which combine NITROGEN . . . PHOSPHORUS, POTASH and, in many cases, weed killers and insecticides, too.

MONSANTO, to help meet the increasing demands for plant foods, has increased quantities of four basic, soluble fertilizer chemicals . . . MONO AMMONIUM PHOSPHATE . . . DI AMMONIUM PHOSPHATE . . . MONO POTASSIUM PHOSPHATE . . . PHOSPHORIC ACID 75.0%.

New uses for WATER-SOLUBLE FERTILIZERS are proving profitable for growers . . . profitable for FERTILIZER MANUFACTURERS. Perhaps these products will fit into your production planning. Contact any District Sales Office, or write MONSANTO CHEMICAL COMPANY, Phosphate Division, 1700-B South Second Street, St. Louis 4, Mo.

DISTRICT SALES OFFICES: Birmingham, Boston, Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Seattle. In Canada, Monsanto Canada Limited, Montreal.

MONSANTO PLANT NUTRIENT CHEMICALS			
	N	P_2O_5	K_2O
Mono Potassium Phosphate (Crystals)	—0—	51.6%	34.2%
Di Ammonium Phosphate (Crystals)	21.0%	53.85%	—0—
Mono Ammonium Phosphate (Crystals)	12.2%	61.61%	—0—
Phosphoric Acid (75.0%) (Liquid)	—0—	54.5%	—0—

New, Modern Agricultural Chemical Plant Opens in India

The formal opening of the new $50,000,000 fertilizer plant at Sindri, Bihar, India was held on March 2, according to an announcement by Chemical Construction Corp. which designed and supervised building of the plant for the government of India.

The Sindri Plant consists of an 80,000 kilowatt power generating station (of which 3600 kw will be used for the fertilizer plant), a gas plant which will generate 33,000,000 cubic feet of hydrogen and nitrogen, an ammonia synthesis plant where the two gases are combined to produce 300 tons of anhydrous ammonia per day, and a sulfate plant where ground gypsum is reacted with ammonia and carbon dioxide to produce ammonium sulfate fertilizer along with calcium carbonate as a by-product.

Additional projects now being considered by the government include facilities for production of ammonium nitrate, urea, methanol, formaldehyde and other products. The Bihar government is considering construction of a phosphatic fertilizer plant nearby which would use some of the intermediates to be produced in the Sindri Plant, general view of which is shown above.

Monsanto Names Barber

Claiborne L. Barber has been appointed as agricultural chemicals sales supervisor for Monsanto Chemical Company's organic chemicals division, St. Louis, Mo., according to an announcement by Robinson Ord, general manager of sales. At the same time, Mr. Ord announced that Donald E. Marringer has been appointed to take over Mr. Barber's position at the Houston, Texas, sales office. Both men have held production and sales positions with the firm.

•

Completing Tenco Fert. Plt.

The Tennessee Farmers' Cooperative is building a new fertilizer plant at Tenco in east Tennessee. The plant is now reported to be 30% completed, according to J. B. Jones, general manager. When finished, the new plant will represent the latest in design and manufacturing equipment. It will double present capacity for production of high analysis fertilizer.

The 7th annual meeting of the Tennessee Farmers' Cooperative was held in Nashville, Tennessee, February 21. Mr. Jones reported that 1951 sales were up 35% over 1950, and approximately 2½ times the 1949 volume. During 1951, another new fertilizer plant was put into production, this one being located at La Vergne in central Tennessee.

•

Hyman Promotes Soloway

S. Barney Soloway has been promoted to assistant director of research of Julius Hyman & Company, Denver, Colorado. Mr. Soloway has been in the company's research laboratory for five years. He was previously chemist in the U. S. Department of Agriculture at Beltsville, Maryland.

•

Rat Brochure Published

Distributors of "Blitz" rat bait, a warfarin product manufactured by J. W. Lawton Co., Sioux Falls, S. D., have produced a novel brochure entitled "A Rat's Eye View of Your Farm" in which the barn is pictured as having "nice beds" and "healthy livestock" and where there is "always a vacancy". "Club Silo" is shown as an attractive night spot just back of the barn and the corn crib sports a sign, "free fresh corn". A henhouse is billed as "The Broiler —tasty chicks". In the foreground of the cartoon a rat is reading a sign which tells him he is welcome here, with the impression that all he has to do to gain an abundance of the good things of life, is to walk in and help himself.

On the back of the brochure, instructions are given on how to ratproof a farm and how to distribute the warfarin bait to the best advantage.

Distributors of "Blitz" are the Midwest Marketers, Sioux Falls.

•

Cotton Farmer Wins Suit

An Arkansas farmer recently received a judgment of over nine hundred dollars for damage to his cotton crop allegedly caused by airplane spraying of a weed-killer. The judgment was against the H. Zimmer Flying Service of Pine Bluff, Ark. The suit was filed by L. J. Rogers, of Sherrill, who claimed that 2,4-D used in an adjoining rice field drifted over onto his cotton crop and reduced the crop from 110 bales to 60.

Five Reasons Why Bemis is Your Best Burlap Bag Source

1 **YOU BENEFIT FROM OUR LARGE OPERATIONS.**

Bemis is the largest importer. Whatever the supply situation, Bemis customers are in the most favorable position.

2 **YOU BENEFIT FROM OUR KNOWLEDGE OF QUALITY OF BURLAP.**

For many years, producers and users alike have accepted Bemis' grading of Indian burlap as the standard for the industry.

3 **YOU BENEFIT FROM OUR QUALITY BAG MANUFACTURING.**

Just one example: Bemis close-stitch seams—11 stitches to 2 inches—are strong, siftproof, dependable.

4 **YOU BENEFIT FROM BEMIS QUALITY PRINTING**

...directly on the bag or on the Band-Label. It helps to sell your product.

5 **YOU BENEFIT FROM BEMIS' LARGE FACILITIES.**

Sixteen plants and seventeen additional sales offices, all strategically located, assure you a dependable source of supply.

Bemis is headquarters for all grades and weights of burlap . . . including widely used 10-oz., and the popular, special-finish Angus, which only Bemis imports.

BEMIS BRO. BAG COMPANY

Bemis

Baltimore • Boise • Boston • Brooklyn • Buffalo
Charlotte • Chicago • Cleveland • Denver • Detroit
Houston • Indianapolis • Kansas City • Memphis
Jacksonville, Fla. • Los Angeles • Louisville
New Orleans • Minneapolis • New York City
Norfolk • Oklahoma City • Omaha • Philadelphia
Phoenix • Pittsburgh • St. Louis • Salina • Seattle
Salt Lake City • San Francisco • Wichita
Vancouver, Wash.

NSDA Meets in Chicago

National Sprayer and Duster Association recently held their winter quarterly meeting in Chicago. H. F. Brandt, chairman of the association's markets committee presented his annual report. He stated that a continuing strong demand for sprayers and dusters through 1952 would continue in the face of restricted materials supplies.

President R. B. Chapin advised the members that the association publicity committee activities are being coordinated with the National Farm Machinery Conservation program through special releases stressing the proper care and use of dusters and sprayers. In conclusion, Mr. Chapin reminded the members of the strategic importance of the equipment they produce in ensuring an adequate food supply for the expanding national population.

•

New Phillips' Sulfur Plant

Phillips Chemical Co. began operation of a new sulfur extraction plant in West Texas, late in February. The plant located near Goldsmith, Texas, is designed to extract sulfur from natural gas at the rate of a quarter of a million pounds per day. Phillips has a second such plant under construction in Crane County in West Texas. Its capacity will be over 100,000 pounds of sulfur per day. Additional sulfur extraction plants are also to be built.

•

Fert. Ind. Wage Violations

The 1951 annual report of the U. S. Labor Department's Wage and Hour Law and Public Contracts Division showed that 68% of the establishments in the fertilizer industry investigated during the past fiscal year were found to have violated the act's minimum wage, overtime pay or child-labor provisions. A total of $10,089 in back wages was paid to 169 employees as a result of the division's activities.

William R. McComb, the division's administrator pointed out that the most extensive were overtime pay violations. He also noted that the division found a sizable minority of establishments had failed to observe the requirement raising the minimum wage from 40 cents to 75 cents per hour. Mr. McComb stated that he wants members of the industry to know that violators found last year were not representative of the compliance record of all employers whose employees came within provision of the act. Moreover, he stated, experience demonstrates that the great majority of employers intend to comply with the act; in most cases the failures are due to misunderstanding the statutory provisions.

•

Huber Retirement Plan

J. M. Huber Corp., New York, producers of agricultural insecticide diluents and other chemicals, recently announced through the annual report of the president, Hans W. Huber, that they had paid to their employees over a million dollars out of their 1951 earnings. These payments are made under the profit sharing and retirement plans of the company. Huber is an important factor in the mining and refining of kaolin clay in South Carolina and Georgia.

•

New Baughman Factory

Baughman Manufacturing Co., Jerseyville, Ill. recently announced the opening of their newest factory building. The building contains 16,000 square feet of floor space and will provide increased facilities for manufacturing bulk feed bodies. According to the release, the Baughman plant now comprises 100,000 square feet of manufacturing, assembling, and storing facilities. A 1900-foot all-weather airstrip and hangar for company airplanes adjoins the plant. The entire community around Jerseyville was invited to an open house at the dedication of the building. About 2500 people attended the festivities.

•

Harry Recher Appointed

Harry Recher was recently appointed as assistant to L. J. Doyle, vice-president in charge of bag and paper sales of Union Bag and Paper Corp., New York. Mr. Recher had formerly been a field representative for Union multiwall bag sales.

Letter to the Editor

I read with great interest the article "Electronic Bug Chaser" appearing in the January issue.

Now, I feel that I must, as a public service, introduce you to "*Harvicide*", a miracle weedkiller produced by the Harvicide Corporation.

"*Harvicide*" is the greatest development in weed control since the invention of the hoe. Containing 100% inactive ingredients, "*Harvicide*" is guaranteed to be non-phytotoxic.

Bill Harvey, president and founder of the Harvicide Corporation, recently announced plans for expansion of production in order to keep up with pressing demands. To finance this expansion, Murray Pryor, treasurer and chairman of the finance committee, will soon be floating a stock issue, with members of the agricultural industry having first opportunity for investment.

In an address before the NAM, Walter Ball, our chairman of the board, reported that much of the credit for the success of the Harvicide Corporation could be attributed to our policy "Millions for Advertising. Not One Damn Cent for Research." Working through established distributors, our sales policy "If You Can't Get 5, Take 2" has met with universal approval.

Knowing that you wish to keep your readers informed as to the latest developments in agricultural pest control, I am sure the above will be of interest to you.

Very truly yours,

THE HARVICIDE CORP.
A. H. BRONSON
Sales Manager

P. S. Just as soon as Allen Lemon, vice president in charge of registrations, gives me the word that we have received our federal registrations, we will embark on a national sales and advertising campaign.

we explore all the corners . . .

We explore every corner of the earth to supply raw materials to manufacturers of fertilizers and agricultural chemicals. If you have a supply problem, write, wire or phone us today.

H. J. BAKER & BRO.

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600 FIFTH AVENUE, NEW YORK 20, N. Y.

Branch Offices: Baltimore • Chicago • Savannah • Tampa

NFA Fertilizer Summary

The National Fertilizer Association, Washington, recently issued a letter report summarizing available information that the association has concerning the USDA's proposed fertilizer expansion program. This program is based on estimates for anticipated usage of fertilizer by individual states in 1955. This calls for the following amounts of plant food:

N	2,185,000 tons
P_2O_5	3,350,000 tons
K_2O	2,100,000 tons

The report continues by summarizing the available components of fertilizers. The additional nitrogen has already been subscribed to by the industry. The present plant capacity for producing superphosphate is ample for the additional USDA requirements. The potash requirements will be met also according to USDA figures. Sulfur and sulfuric acid have eased slightly in the past few weeks due to a reduced demand by the textile industry. However, the report warns, there is still no reason for optimism on sulfur.

•

Turf Fungicide Noted

Mallinckrodt Chemical Works, St. Louis, Mo. has announced the development of a turf fungicide, "Calocure". The product is a formulation of mercury chlorides with synergists. "Calocure" was developed in cooperation with the Rhode Island Agricultural Experiment Station under the direction of Dr. Frank L. Howard.

Its makers state that the material is designed for application in all seasons for control of dollar spot, brown patch and snow mold. Full information is available from Mallinckrodt Chemical Works, St. Louis 7, Mo.

•

Jap Fertilizers Up

The Ministry of International Trade and Industry, Tokyo, recently announced that the production of chemical fertilizers rose considerably in January. Nitrogenous fertilizers registered 108% of its goal, while phosphates were 111% of the goal. The Ministry also announced that ammonium sulfate output reached an all time high, even for pre-war years.

•

New Hough Representative

Carl W. Tuohey has been appointed representative of The Frank G. Hough Co., Libertyville, Illinois,

CARL W. TUOHEY

for the Hough district comprising the states of New York, New Jersey, Pennsylvania, Virginia, Delaware, West Virginia, and New England. He will work with company distributors in these states in the sales of Hough "PAYLOADER" tractor-shovels.

•

Myers Board Chairman Dies

John C. Myers, chairman of the Board of F. E. Myers and Bros., manufacturers of pumps and sprayers, Ashland, Ohio, died March first at his home in Ashland.

•

Sulfur Export Quota Out

An export quota of 230,000 long tons of crude sulfur for the second quarter of 1952 has been announced by the Office of International Trade. This is the second part of the six month export quota of 465,000 tons which was announced by OIT early this year. (A quota of 235,000 tons had been established previously for the first quarter).

Export quotas on sulfuric acid will remain the same for both the first and second quarters, at 400 short tons. The last quarter of 1951 had a quota of 450 tons, made as a quantity limit on outgoing shipments.

S. C. Fertilizer Meet Set

The annual meeting of the South Carolina Fertilizer Conference has been set for May 21-22, according to B. D. Cloaninger, head of the department of fertilizer inspection and analysis, Clemson College, Clemson, S. C., where the meeting will be held.

Dr. Cloaninger states that all fertilizer manufacturers, dealers and salesmen operating in South Carolina are invited to attend and that reservations for rooms should be made at the Clemson House (hotel), headquarters for the conference.

A program including speakers representing both industry and state agricultural workers is being planned.

•

Aldrin Registered Now

Federal registration for aldrin insecticides for control of soil insects has been announced by Julius Hyman & Co., Denver, Colo., manufacturers of the material.

F. W. Hatch, agricultural products manager for Shell Chemical Corp., New York, distributors of aldrin, has pointed out that the use of aldrin for control of soil insects will increase production of corn, peanuts, sugar beets, sugar cane and small grains. Among the pests on which aldrin is effective, are rootworm, wireworm and white grub, it is stated.

Tests thus far have shown increases of peanuts up to 50% on aldrin-treated plots as compared to the check, with better quality coming from the treated plots. Iowa State College has reported as much as a 92% reduction in infestation of corn root worm in aldrin-treated plots, compared with check plots.

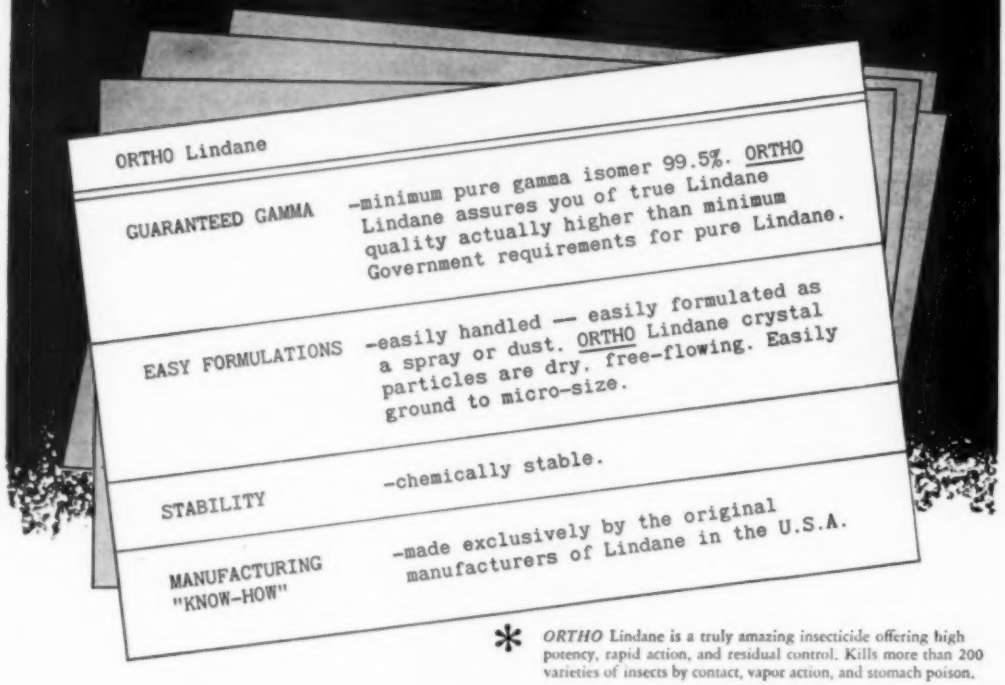
In addition to its agricultural uses, aldrin is expected to be useful in control of turf insects on golf courses and in public parks.

•

Fertilizer Stock Sold

Jacksonville Fertilizer Company, Jacksonville, Texas, recently announced that W. S. Tyler has purchased the stock interest of Henry Taylor, Jr. Mr. Tyler is now general manager and president of the fertilizer plant.

FORMULATORS!
only ORTHO Lindane* gives you all these advantages:


ORTHO Lindane
GUARANTEED GAMMA
-minimum pure gamma isomer 99.5%. ORTHO Lindane assures you of true Lindane quality actually higher than minimum Government requirements for pure Lindane.
EASY FORMULATIONS
-easily handled — easily formulated as a spray or dust. ORTHO Lindane crystal particles are dry, free-flowing. Easily ground to micro-size.
STABILITY
-chemically stable.
MANUFACTURING "KNOW-HOW"
-made exclusively by the original manufacturers of Lindane in the U.S.A.

* *ORTHO* Lindane is a truly amazing insecticide offering high potency, rapid action, and residual control. Kills more than 200 varieties of insects by contact, vapor action, and stomach poison.

T.M. REG. U.S. PAT. OFF.: ORTHO

always—you profit with ORTHO

For complete information, "Story of Lindane," write:

CALIFORNIA SPRAY-CHEMICAL CORP.

Elizabeth, N. J.
Maryland Heights, Mo.
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Medina, N. Y.
Goldsboro, N. C.
Shreveport, La.
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Home Office: Richmond, California

World leader in scientific pest control

ORTHO

SCIENTIFIC PEST CONTROL

"Sulfoxide" Okayed by U.S.

The Meat Inspection Division of the Bureau of Animal Industry has approved the use of the insecticide synergist "Sulfoxide," it has been announced by S. B. Penick & Co., New York, makers of the material. "Sulfoxide" is available in technical form, in a 40% solution and combined with pyrethrins in various concentrates.

•

Spray Assn. Names Officers

In a recent organizational meeting, the "Washington Chemical Ground Applicators Association" elected the following officers: John F. Harshman, president; T. A. Ziegler, vice-president; Stuart W. Turner, secretary-treasurer; A. H. Hembree, chairman and H. H. Smith, committeeman.

The group sends out monthly newsletters and expects to hold its second convention sometime in October, 1952, according to Mr. Ziegler, vice-president, who operates a custom spraying business in Yakima, Washington.

•

British Group Meets

The British Fertilizer Society was to hold its annual meeting April 3, at the North British Hotel, Edinburgh, Scotland. A discussion of mechanical handling of fertilizer materials was to be led by J. P. A. MacDonald, according to advance information from England.

•

AEPCO Report Available

Copies of the "Annual Report for 1951" of the Association of Economic Poisons Control Officials are available, according to Dr. Albert B. Heagy, secretary-treasurer of the group, University of Maryland, College Park, Md. A charge of $2 per copy is being made to cover expenses involved in the publishing of all papers presented at the 1951 meeting in Washington in October. Dr. Heagy is handling the orders.

•

Chemurgic Council Elects

In its seventeenth annual conference, the national Farm Chemurgic Council re-elected as president, Wheeler McMillen, editor, the *Farm Journal*. The meeting was held in St. Louis, Mo. Mr. McMillen's son, Robert, was named secretary of the Council and John W. Tichnor was re-elected treasurer as well as continuing as general manager of the Council's activities.

•

N. J. Group Elects

The New Jersey Mosquito Extermination Association elected as president, Floyd P. Ayers, Bay Head, N. J. at the group's annual meeting in Atlantic City, in March. He succeeds M. M. Stallman, East Orange. Other officers named included Charles T. Foulk, II, Bloomfield, first vice-president; Dr. Clifton J. Strauss, New Providence, second vice-president; Bailey B. Pepper, New Brunswick, secretary, Daniel M. Jobbins, New Brunswick, assistant secretary, and Lester W. Smith, Metuchen, treasurer.

"ETHYL" (TRADE MARK) BENZENE HEXACHLORIDE TECHNICAL — ETHYL CORPORATION

BENZENE HEXACHLORIDE

12-14% GAMMA-TECHNICAL-FINELY FLAKED

A prime advantage of insecticides formulated with BHC is their QUICK killing action.

•

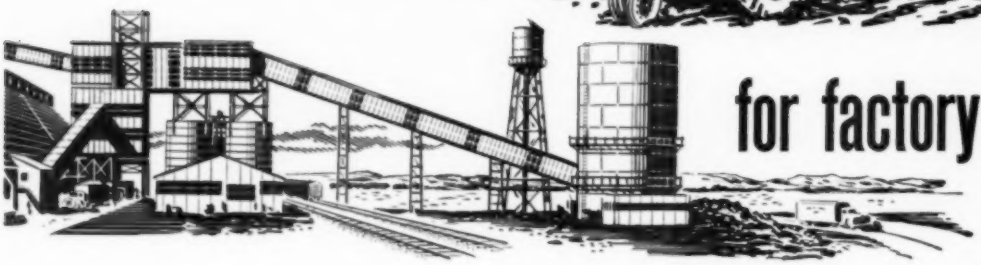
"ETHYL" technical BHC is manufactured in the heart of the cotton belt at Baton Rouge, Louisiana.

ETHYL CORPORATION

100 PARK AVENUE NEW YORK 17, N. Y.

MORE POTASH

for farm



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The Modern, New Carlsbad, New Mexico Plant And Refinery of

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Kolker Opens New Plant at Houston

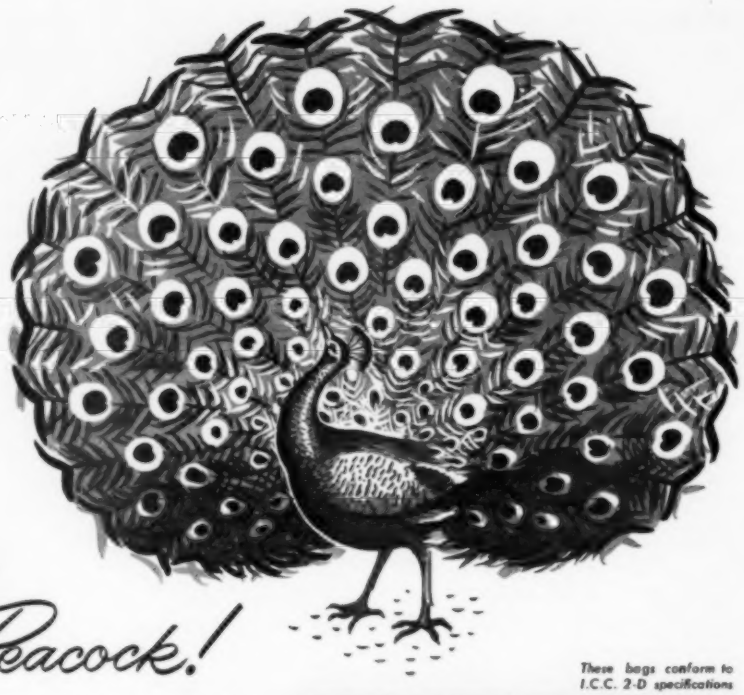
Above: General view of new Kolker Lindane plant at Houston

A new plant for the manufacture of lindane has just been put into operation in Houston, Texas, by Kolker Chemical Works, Inc., Newark, N. J. (a subsidiary of Diamond Alkali Co.) The new plant, said to be one of the largest in the world for the production of pure gamma isomer benzene hexachloride, is now in full production of lindane. The plant is of the wall-less type of construction popular in the southwest. In addition to lindane, the plant is also turning out high gamma technical BHC for use in regular insecticide formulations. DDT is produced in a different unit of Kolker's Houston works. Sales of all Kolker products will still be handled from Newark, N. J. Formed in 1946, the Kolker company has risen rapidly to a position of prominence in the production of agricultural insecticides and herbicides. The company was bought by Diamond Alkali in August, 1951, and now operates as a Diamond subsidiary. Houston was chosen as the site for this new plant because of its proximity to both raw materials (chlorine and benzol) and consuming markets. Kolker's DDT plant at Houston was shown on the front cover of AGRICULTURAL CHEMICALS, April, 1951.

•

Dow Spring Booklet

The spring, 1952 issue of *Down to Earth*, published by the Dow Chemical Co., Midland, Mich., is now available.



PROUD *as a Peacock!*

These bags conform to I.C.C. 2-D specifications

Betner is indeed proud as a peacock . . . proud of the "Duo-Tite" bag. And with good reason. The Betner "Duo-Tite" bag *positively prevents* sifting.

The contents are protected—top and bottom—by the "Duo-Tite Turnover." It can be made with combinations of materials . . . preprinted up to four colors . . . it's constructed with special liners . . . it's folded, glued and heat-sealed to prohibit sifting.

Insecticides, fertilizers, chemicals, any bulk powdered product can be packaged with economy and sales appeal in a "Duo-Tite" bag.

COMPLETE SERVICE!

Drop us a line. We'll gladly recommend the proper machinery for closing and filling bags. And we'll gladly show you our broad range of finished bags, ideas and "know-how."

• **Whatever the packaging need, there's a Betner bag . . . FILL IT!**

Benj C Betner Co *Devon, Pa.*

***Plants also located in:* Richmond, Virginia; Paris, Texas; Appleton, Wisconsin; Los Angeles, California**

Cleaning 2,4-D Rigs

How to clean 2,4-D from spray equipment was explained in a recent Cornell University bulletin, as follows:

1. Fill the spray tank, lines, boom and nozzles with 1 part household ammonia to 100 parts water.

2. If hot water is used, allow it to stand 18 hours.

3. If cold water is used, allow it to stand 36 hours.

4. Rinse two or more times with clean water.

If the ester form of 2,4-D has been used, rinse first with kerosene or fuel oil, then wash out with soap suds before beginning the ammonia soak.

However, the station recommends that whenever possible, separate equipment be used for spraying with 2,4-D, 2,4,5-T and similar preparations. The above suggestions are to be used in cases where the same rig must be employed for different purposes.

One final suggestion is made, and that is, after cleaning the rig thoroughly as outlined above, test it by spraying a few sensitive plants like tomatoes, beans, etc. "If nothing happens in a day or two, it's probably safe to use the rig", the bulletin concludes.

•

NAC Names Taylor Director

J. M. Taylor, president of Taylor Chemical Co., Aberdeen, N. Carolina, has been named a director of the National Agricultural Chemicals Association, the group has announced. He organized the Taylor Chemical Co. in 1933 and took over the North Carolina holdings of Woolfolk Chemical Co.

USDA REPORT

(Continued on Page 51)

tected so as to spread the cost of control to growers who benefit.

11. Federal assistance to States in controlling insects and plant diseases should be made contingent upon enforcement of adequate State regulations, except where such action would interfere with the fulfillment of Federal responsibility to other areas.

12. The provision of contingency funds should be continued to meet or prevent emergency situations.

13. The Federal Government should provide adequate insect and plant disease control on Federal lands.

14. Changes in Federal insect and plant disease control programs to encourage greater State and local responsibility should be scheduled to allow time for necessary adjustments.

Serving with Mr. Minor on this study group were the following:

G. Harris Collingwood, Legislative Reference Service, Library of Congress, Washington, D. C.

Fred V. Heinkel, president, Missouri Farmers Association, Inc., Columbia, Mo.

L. S. Hitchner, executive secretary, National Agricultural Chemicals Association, Washington, D. C.

G. D. Humphrey, president, University of Wyoming, Laramie, Wyoming.

Roy E. Yung, Director of Agriculture, State of Illinois, Springfield, Ill.

INCREASE MORTALITY WITH BARDEN CLAY

Cornell University tests on a variety of commercial diluents (without toxicant) give Barden Clay the highest mortality rating—93.3% on fourth instar Mexican bean beetle larvae. Tests at Crop Protection Institute reveal consistently higher mortalities with dusts and sprays using Barden Clay. And Barden's fine particle size—90% less than 2 microns—means more efficient dispersion, greater surface area, better suspension properties...practically eliminates abrasive wear of pipes and nozzles.

It costs no more to be sure with Barden Clay. Add *extra power* to your product...*extra punch* to your sales with Barden Clay. Samples on request.

7-Point Barden Score	
✓	Improved dispersion
✓	Lower abrasion
✓	Better coverage
✓	Better retention
✓	Higher mortality
✓	Greater uniformity
✓	Maximum economy

HUBER — World's Largest Producer of Aerflated Kaolin Clay

For Dust or Spray... use Barden Clay— the Low-Cost Scientific Diluent

WEED CONTROL with the big three DINITROS

SINOX-PE, SINOX-W, and SINOX GENERAL, the original dinitro weed killers, have been successfully used for weed control for many years on millions of acres. Though similar in composition, each of the SINOX dinitro weed killers has its own individual characteristics and uses. Through research and development Standard Agricultural Chemicals, Inc. has devised weed control methods and formulas which utilize to best advantage the individual characteristics of each of the SINOX Weed Killers for specific weed control jobs.

SINOX GENERAL

Preharvest spraying of flax and beans. Potato vine killing; general contact spraying and for use in established alfalfa and strawberries.

SINOX-W

Selective spraying of peas, seedling alfalfa, flax, onions, potatoes, and grains.

SINOX-PE

Pre-emergence spraying of, cotton and beans.

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(2,4-D—Amine)

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Denver Court Rules Against Hyman & Co.

RULING that the insecticides aldrin and dieldrin are the property of Velsicol Corporation, Chicago, the Denver District court on March 17 decided against Julius Hyman & Company, Denver, in a suit which has been in litigation for some time.

The court ordered Julius Hyman & Co. to halt the manufacture and sale of the two insecticides, and also ordered the Denver concern to assign to Velsicol Corp., patent applications and patents covering aldrin and dieldrin and their intermediates and related compounds. Hyman was also ordered to account to the Velsicol Corp. for damages and profits involved in the making and selling of these materials.

A spokesman for the Hyman company said that his firm "in all likelihood" will appeal the decision.

•

PCO's to Texas in Oct.

The Rice Hotel, Houston, Texas, is the site of the annual meeting of the National Pest Control Association for 1952, the group has announced. The dates will be October 20-22.

•

Fert. Safety Conference

An invitation has been extended to the fertilizer trade, particularly plant managers and others interested in safety, to attend the Governor's Safety-Health Conference and Exhibit at the Lord Baltimore Hotel, Baltimore, Md., May 8 & 9.

A. B. Pettit, supervisor, Industrial Health and Safety, Division Chemical Corp., Baltimore, will be chairman of the meeting and Walter W. Lehle, Assistant to the Director of Operations, Mathieson Chemical Co., Baltimore, will be moderator of a discussion panel.

Appearing on the panel, will be the following: Ralph Frazer, vice-president, Summers Fertilizer Co., Baltimore; T. M. Bloom, Superphosphate and Mixed Fertilizer Plants, Davison Chemical Corp.; George F. Dietz, safety director, Fertilizer Manufacturing Cooperative, Inc., Baltimore; and F. W. High, Manager of Operations, Baugh Chemical Co., Baltimore.

Mr. Pettit points out that there will be no prepared speeches as such, but rather, an informal discussion on fertilizer plant safety.

Fertilizer plants are requested to submit specific safety and fire protection questions, in writing, to Mr. Lehle by April 24, to form a basis for discussions. Specific questions will also be submitted from the floor.

•

Bemis Sales Exec. Dies

Howard Marahutz, supervisor of waterproof sales for Bemis Bro. Bag Co., died March 10 from injuries received earlier in an auto accident.

He had joined Bemis in 1916 as a salesman and except for two years of service in the U. S. Navy in World War I, was with the company until his death. He had been in his supervisory job since 1943.

King Joins Poulsen Co.

Richard B. King has been named general sales manager of A. E. Poulsen & Co., Los Angeles, manufacturers of "Uni-Blendor" and other processing equipment for insecticides and fertilizers. He will be in charge of domestic and export sales.

RICHARD B. KING

Before joining Poulsen, he was with Struthers-Wells Corp. as district sales manager in Chicago, and also in the engineering department of E. I. duPont de Nemours & Co., for four years.

•

New Becco Booklet

Buffalo Electro-Chemical Co., Buffalo, N. Y. recently issued an eight page booklet covering seed treatments with peroxygen chemicals.

New Legislation Needed---Delaney

WITH completion of 18 months of inquiry regarding the effect of chemicals in and on food, James J. Delaney, chairman of the Congressional Committee making the investigation declared in a United Press release printed in the New York *Times* of March 9, that a law is needed to stop some producers and processors from putting poorly tested and possibly harmful chemicals into the nation's food supply.

Hoping to receive a more specific statement from the committee chairman for publication in the special issue in connection with the NAC Association convention, *Agricultural Chemicals* asked Mr. Delaney for such a brief summary of his recommendations for new legislation.

His reply follows:

"I am inclined to think, at this time, that some new legislation dealing with the addition of untested substances to foods should be enacted. However, the hearings have just been completed, and no final decision will be reached until all the testimony has been considered and a report made to the Congress."

N. Central A.A.E.E. Meets

Entomologists from a dozen midwestern states were meeting in St. Paul, Minn., March 27 and 28, as this issue went to press. The North Central Branch of the American Association of Economic Entomologists were to hold their annual conference at the St. Paul Hotel with a program including the presentation of many technical papers, covering fruit insects, forage and grassland pests, insects affecting man and domestic animals, insecticides and applicators, and pests of forests and ornamentals.

Dr. E. F. Knipling, assistant chief, Bureau of Entomology and Plant Quarantine, U.S.D.A., Washington, D. C., president of the A.A.-E.E. was to appear on the program. R. C. Smith is branch president, J. H. Lilly, vice-president and J. W. Apple, secretary-treasurer. Dr. J. H. Bigger, Urbana, Ill. is chairman of the program committee.

•

Wasatch Co. Expands

Wasatch Chemical Co., Salt Lake City, recently installed a 30 ton per hour capacity fertilizer mixing plant and made other improvements in bulk handling methods. Some of these were the addition of a new 15-ton semi-trailer added to the seven-truck fleet and full-time agricultural research.

•

New Ass'n for Calif.

A new organization for the purpose of coordinating research and field data in the San Joaquin Valley of California, was formed February 27 in Fresno. To be known as the "Central Valley Agricultural Forum", the group will meet on Wednesdays of every third month. Topics for discussion will include current work on weeds, insects and plant diseases of crops grown in the valley.

Officers elected at the organizational meeting were: Tom Heffernan, Producers Cotton Oil Co., Fresno, president; and Charles Grimm, Agricultural Commissioner for Kern County, vice-president. John Hoyt, Fresno County Farm Adviser was named secretary-treasurer and Ross Miller, S. A. Camp & Co., program chairman.

Presiding at the opening meeting, as temporary chairman, was Ed Littooy, vice-president, Colloidal Products Corp., San Francisco. Fred P. Roullard, Fresno State College, was in charge of arrangements for the first meeting.

Some 120 representatives of state and county departments of agriculture, University of California, agricultural chemical manufacturers and others associated with application equipment, form the core of membership in the new association.

In addition to those from the immediate vicinity in attendance at the Feb. 27th meeting, were Dr. Mohan Singh, storage entomologist for the Central Government of India, Dr. Leslie Smith, University of California, Davis; and Gordon L. Smith, University of California, Berkley.

•

New Phytopath to Conn.

Gordon S. Taylor was recently appointed to the staff of the Connecticut Agricultural Experiment Station, New Haven, Conn. According to the announcement, Mr. Taylor received his PhD from Iowa State University in March and his first assignment at Connecticut will be an attempt to find control measures for verticillium wilt of potatoes.

•

Minn. Plant Expands

Welcome Agricultural Chemical Co., Welcome, Minn., has recently installed five additional fertilizer curing bins with total capacity of 2,500 tons. According to J. A. Schuler, president of the firm, the volume of business has doubled each year for the past four seasons. The first year's business was 2,000 tons; the second, 5,400 and last year was 10,000 tons, he reports. The five new bins will enable the plant to produce 20,000 tons, but Mr. Schuler does not expect the figure to go that high this year.

•

Plant Food Council Meeting

Meeting at the Homestead Hotel, Hot Springs, Va., June 19-22, the American Plant Food Council expects to hold one of the largest meetings in its history, Council representatives have stated. Actual program plans had not been announced at press time, but speakers representing the industry, the U. S. Congress, and other state and federal agencies are being selected for the program. Committees are at work making arrangements for the annual contests in golf and tennis.

•

More U. S. N Production

Ten new nitrogen plants have been granted fast tax write-off allowances by the Defense Production Administration, it has been announced. The plants will cost nearly $115 million, and are expected to bring an additional 425,000 tons of annual N production capacity to the U. S.

Allied Chemical & Dye Corp. will build a plant at Omaha, Nebraska, costing $24 million, with an annual capacity of nearly 62,000 tons of nitrogen. The largest plant, in capacity, however, will be erected by Sid Richardson, at Pointe-ala-Hache, La. It will have a yearly capacity of 86,400 tons and will cost $9 million.

Other plants which will receive fast write-offs of more than a million apiece, are:

Co-operative Farm Chemicals Association, Lawrence, Kans., a plant to cost $13,812,000 having capacity of 51,800 tons of nitrogen annually.

Deere & Co., two plants in Missouri to cost $18,500,000 with a combined capacity of 57,600 tons.

Pacific Chemical Co., Inc., Pasco, Wash., a $5,735,00 plant, with capacity of 18,100 tons.

W. R. Grace & Co., two plants in Illinois to cost $15,466,000 with a combined capacity of 72,000 tons.

National Chemical Corp., Yazoo City, Miss., a plant to cost $7,212,446 with capacity of 34,500 tons.

Delta Chemical Corp., Buras, La., a plant to cost $8,892,200 with capacity of 25,900 tons.

The Defense Production Administration is aiming at a total U. S. nitrogen capacity of 2,930,000 tons by 1955 as compared with the domestic capacity of 1,540,000 tons as of Jan. 1, 1950.

Field Crop Weed Control

A bulletin "1952 Weed Control in Field Crops" has been issued by the New York State College of Agriculture, Ithaca, N. Y. Issued as Cornell Extension Bulletin 821, it was prepared by Stanford N. Fertig. It lists in tabular form a complete set of chemical weed control recommendations for 1952 for use of various herbicides on corn, oats, wheat, legumes, permanent pastures, hay and rotational pastures, sudan grass, woody species, etc. Copies are available.

•

New NFA Fertilizer Bulletin

Fertilizer Process Progress, a new bulletin published by the National Fertilizer Association, made its initial appearance with the February 1952 issue. This is the NFA's newest publication, designed to keep the fertilizer industry abreast of current developments in fertilizer manufacturing and processing, according to Russell Coleman, president.

The first issue contains an article on nitric acid acidulation of phosphate rock and other items of interest to the fertilizer industry.

•

Conn. Field Day in Aug.

Announcement has been made of the date for the annual Field Day of The Connecticut Agricultural Experiment Station, New Haven. This year's event is scheduled for August 20, at the Station's Mt. Carmel Experimental Farm. In addition to special tobacco exhibits, all of the regular field plots at Mt. Carmel will be open for inspection and the entire staff will be present to explain their current research.

•

Fertilizer Sales Lagging

Although the over-all fertilizer supply compares favorably with the past few years, the sulfur shortage and delayed buying are bothering both industry and the Department of Agriculture. The National Fertilizer Association has estimated that the superphosphate supply will run about 90% of the 1950 supply because of the sulfur shortage.

Because of slow buying, the superphosphate shortage will not show up for some time, industry spokesmen warned. They also stated that the late buyers will be the hardest hit and will have to take mixed fertilizers with lower superphosphate content. Industry spokesmen predict however that there will be plenty of nitrogen and potash for the mixtures.

The U. S. D. A. estimated that the potash supply will be up about five per cent with an estimated availability of 1,515,000 tons for use in fertilizer. They also announced that the nitrogen supply may be seven per cent above last year's total, although an increase in military requirements might upset the improvement.

GUEST EDITORIAL

(*Continued from Page 39*)

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That Increase The Effectiveness Of Insecticides, Fungicides, Herbicides and Defoliants

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Sulphur

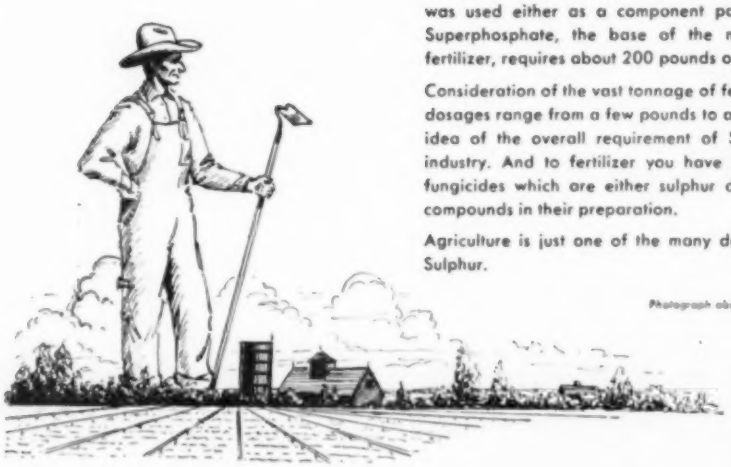
Thousands of tons mined daily, but where does it all go?

THE DEPARTMENT OF AGRICULTURE reports that in 1950 some 336,000,000 acres of land in the United States were under crop cultivation. That's a lot of acreage.

But where, you might ask, is the connection with Sulphur? Fertilizer, to take just one phase of agriculturally-used chemicals in which Sulphur was used either as a component part or as a processing element! Superphosphate, the base of the most widely used manufactured fertilizer, requires about 200 pounds of Sulphur for every ton produced.

Consideration of the vast tonnage of fertilizer used in agriculture — and dosages range from a few pounds to a ton or more per acre — gives an idea of the overall requirement of Sulphur for this one division of industry. And to fertilizer you have to add all the insecticides and fungicides which are either sulphur derivatives or have used sulphur compounds in their preparation.

Agriculture is just one of the many destinations of great tonnages of Sulphur.



Photograph above shows our loading dock at Galveston, Texas

Texas Gulf Sulphur Co.

75 East 45th Street, New York 17, N. Y.

Mines: Newgulf and Moss Bluff, Texas

this outstanding progress in the national agricultural picture. California farmers, for example, have tripled the state's farm income in the past 10 years and for the past two years have enjoyed the top farm income in the Nation.

Leadership of the Western United States in the use of agricultural chemicals has been highly significant in the development of modern agriculture. This leadership has been manifest not only in the use of fertilizers, minor elements and pesticides, but is also typified by the development of specialty-application machines embodying concentrate sprays, airplane applications, and new-type mechanized ground machine equipment.

The west is also a center of agricultural research in all fields of scientific agriculture, both applied and theoretical. The Universities, experiment stations and industries, including chemical and mechanical, all contribute materially to advances in agriculture through such scientific endeavors.

It is noteworthy that many of our fine new pesticides have also been originated in the West, or have had their first commercial use and application in the West. I am sure that many old timers will recall that basic lead arsenate was invented and first used in the Western United States. Standard lead arsenate method of manufacture was also developed here. All of our phytonomic oil sprays originated in the West. Soil fumigants and their commercial field applications have largely been a product of the Western United States.

It is also noteworthy that one of the most recent developments in the use of pesticides for the control of soil insects originated in Western United States. I refer in particular to the use of insecticides as a coating on seeds for the control of such soil insects as wireworms.

If I recall correctly, DDT was first used on agricultural crops in the West. Methoxychlor, likewise, was first used on agricultural crops and animals in the Western United States. Sulfenone, aldrin and dieldrin represent three additional new insecticides coming from the Western United States.

The West is an area where insect pests abound, where mechanized and highly specialized agriculture characterizes modern developments and under such conditions it is only to be expected that leadership in the development and use of agricultural chemicals should be outstanding.

Science all over the nation so far has only opened the door to the scientific development which farmers can expect in the future. The horizons extend far beyond the range of our immediate vision. It is at meetings such as those held by the NAC, that timely information on agricultural chemicals forms the basis for progressive advances and future development of agriculture.★★

BULLETINS

(*Continued from Page 85*)

sion of Union Carbide and Carbon Corporation. Its physical and chemical properties, shipping data and suggested uses are described in a recently-issued technical bulletin.

Derivatives of N-ethyl ethanolamine can be used as emulsifying agents in textile finishing processes and as insecticides and fungicides.

Copies of this new technical bulletin (F-7831) are available from Carbide and Carbon Chemicals Company, 30 East 42nd Street, New York 17, N. Y.

This "Brand" sets the *Standard for Quality* in Rangeland Brush Clearance

Here's another example in which Pittsburgh sets the *Standard for Quality!* All Pittsburgh Brush Killers now contain the new low volatile ester Tetrahydrofurfuryl (THFE*). That means that mesquite and other brushes and woody growths can now be eliminated from rangeland economically and with minimum danger to valuable crops. Pittsburgh has a complete family of brush killers to meet every control need. Pittsburgh Brush Killer 22 effectively controls general rangeland brush and weeds. And for the control of mesquite, briars, sagebrush, scrub oak and other hard-to-kill woody growth, order Pittsburgh Low-Vol 4. ● Write today for free information bulletin on Pittsburgh *Quality-Controlled* Brush Killers.

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Chemurgic Council Meets

The 17th annual conference of the National Farm Chemurgic Council was held March 11 and 12th in St. Louis, Mo. Among the topics discussed at the meeting were Krilium, Terralac, castor beans and Kenaf. Monsanto Chemical Co., St. Louis, showed a 20 minute motion picture on Krilium for the first time. Terralac is a new synthetic sow's milk developed by Chas. Pfizer and Co., which permits baby pigs to be taken from their mothers in 24 to 48 hours.

FUNGICIDES

(*Continued from Page 91*)

data, as given in the tables, are averages of the two Latin squares (eight replications).

Stand counts were made on three separate dates (May 23 and 31, and June 14) and the average germination for each treatment on the three dates is shown in Table 3. When the data were analyzed statistically it was found that the differences between the treatments were highly significant.

The Arasan treatment, when used alone, gave stand counts significantly higher than for the treatments in which Nitragin was used alone, and for the control. The Arasan plus Nitragin treatments was a close second to Arasan alone, except for the slight delay in emergence as shown by the count on May 23 (Table 3).

On November 2 the soybeans were harvested with a small soybean thresher. Using 60 pounds as the weight per bushel, the average calculated yields in bushels per acre are given in Table 4. The yield differences between treatments were not significant.

As far as could be determined, the field in which the soybeans were grown had not been planted to soybeans previously. Examination of the roots of the beans at harvest time did show some root nodulation on all replicates regardless of treatment. The plants from the Nitragin-treated seed, however, had considerably more nodulation than did those from seed not receiving the Nitragin treatment.

The use of the Arasan seed treatment significantly increased the stand counts of the soybeans in this test. Root nodulation was heavier on the plants grown from seed which had been inoculated with Nitragin just prior to planting. Although Arasan plus Nitragin increased the average acre yield approximately one bushel over the control, and about two bushels over Nitragin alone, the yield differences between treatments were not significant.

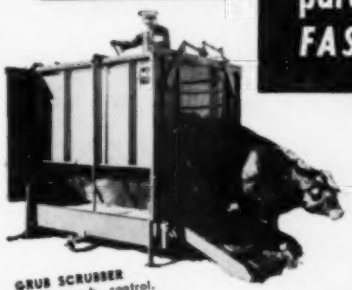
Table 3. Average germination of soybeans for each treatment by dates

Treatment	May 23	May 31	June 14
Nitragin	60.4	66.8	66.8
Arasan	71.6	77.9	77.8
Arasan + Nitragin	62.6	76.1	75.9
Control	49.1	61.1	60.5
L.S.D. at 5% level	9.6	7.4	8.0
L.S.L. at 1% level	13.0	10.1	10.9

Table 4. Average yields of soybeans in bushels per acre by treatments

Treatment	Bushels per acre
Nitragin	40.13
Arasan	41.05
Arasan plus Nitragin	42.02
Control	40.92
L.S.D. at 5% level	N.S.

SPRAY-DIP controls ALL cattle parasites . . EASIER, FASTER, BETTER!



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Better because complete coverage is automatic . . . 150 gallons per minute is driven through 27 nozzles to drench every inch of the animal.

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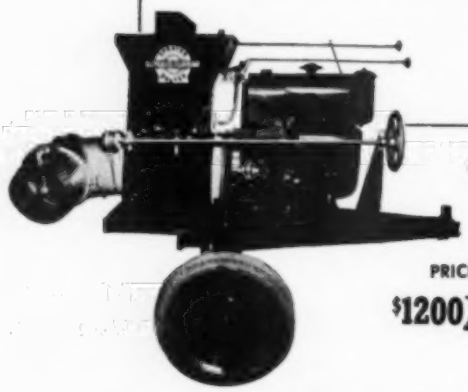

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- ✓ **Light weight permits its use on soft ground**
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- ✓ **Complete coverage is achieved using up to 50% less materials**
- ✓ **No booms mean no over balance on rough terrain and it can be used in much narrower spaces**
- ✓ **Air, not water, is the carrier; there is no run-off**
- ✓ **Range up to 125' vertically and 200' horizontally**
- ✓ **Air velocity controlled from zero up to 150 mph**
- ✓ **One man operated**
- ✓ **Spray and dust density readily controlled**

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Manufacturers of the Original "Mist" Sprayer-Duster

Cotton Seed Treatment

The National Cotton Council, Memphis, in a recent bulletin called attention to the fact that seed treatment with organic mercury dusts will free cotton seeds of the organisms that cause seed decay and damping-off or sore-shin. The treatment also helps prevent angular leaf spot, boll rot and other diseases of fiber and boll deterioration. The Council said that among materials recommended for treating cottonseed are "Ceresan," "Dow 9-B" and "Spergon."

•

Trenton Fertilizer Pres. Dies

John V. B. Wicoff, President of Trenton Fertilizer Co., died February 25th in Princeton Hospital, Plainsboro, New Jersey. He was 73 years old. Mr. Wicoff was also president of the Trenton Clearing House, and served as secretary and director of the Walker Gordon Laboratory of Plainsboro. He had been extremely active in civic affairs, being chairman of the Plainsboro township committee since 1922. He was also former president of the Board of Education.

•

Oklahoma P. C. Conference

The second annual Pest Control Short Course was held recently at Oklahoma A & M College, Stillwater. Approximately fifty persons registered at the meeting which was sponsored by the Oklahoma Pest Control Association. The sessions covered various phases of pest control.

The association also held their annual business meeting and elected the following as officers: Tom Graham as president; J. E. Griffin as vice-president and J. J. O'Conner as secretary-treasurer.

•

Fertilizer Dealers Meet

The annual Fertilizer Dealers Conference was held recently at the University of Nebraska College of Agriculture. The meeting was designed for fertilizer dealers in Nebraska and surrounding states. Most of the speakers at the meeting were staff members of the university. Latest information on fertilizer experiments was discussed.

Wis. P. C. O. Conference

The seventh annual Pest Control Operators conference was to be held in Madison, Wisconsin April 3rd and 4th. Among the topics for discussion on the program were hazards and precautions with insecticides, pest control in food processing and dispensing establishments, city mosquito and fly control, thermal generators and rat control. Among the speakers at the meeting were Dr. Bernard Conley, J. Lyell Clarke, Van L. Phillips and Dr. E. F. Knipling.

•

FERTILIZER TRENDS

(*Continued from Page 65*)

assume, therefore, that 1 ton of fertilizer rightly used on land that needs it, can be made to add 2 tons of organic matter to the soil, even when all the crops are harvested and hauled away.

While discussing organic matter, a few words about organic sources of plant nutrients is appropriate. Is there any basis for claims made by the "organic cult" that chemical fertilizers are causing the American people to die prematurely? The presentation of a few authentic statistics (figures 11 and 12) can tell the story better than a lecture on the subject. These charts show that North Carolina, the state which uses more fertilizer than any other state, has a low rate of deaths by heart disease and cancer compared to the record of the entire United States. Its rate of 183.5 deaths (per 100,000 population) from heart disease compares with 306.8 in the entire U. S. Its cancer rate is 69.3 against a national rate of 130.1. Georgia, the number two user of commercial fertilizer, likewise has a relatively low death rate from these causes. Yet, the anti-fertilizer group insists that the application of "manufactured" plant food is ruining the health of the nation!

How can the "organic gardening school" continue to make their statements in the face of such definite facts? The answer is, obviously that their statements are based on something other than factual data; and the people who believe their stories no doubt have lacked the opportunity to learn the actual facts of the matter.

In summary, it seems certain that fertilizer usage in the United States will continue to increase. How much? That is the real question. However, some realistic estimates have been projected three years ahead by the Bureau of Agricultural Economics of the Department of Agriculture. Compared to 1950 figures, B. A. E. estimates that production needed in 1955 will be as follows: Nitrogen, up 93% over 1950; P_2O_5, up 54% over 1950; and K_2O, up 74%.

Whether these increased tonnages are realized and whether American agriculture will continue to see the need for more and more commercial fertilizers for increased yields, remains to be seen. Only history will tell the whole story, but from this point, the prospects for a bright future for the fertilizer trade appear good indeed.

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Phillips is producing nitrogen fertilizer materials at full capacity. But even our tremendous rate of production isn't always sufficient to meet today's demand. We'll do our best for you. Keep us in mind if you need nitrogen in any form.

AMMONIUM SULFATE—Phillips *66* Ammonium Sulfate is a free-flowing 21% nitrogen material! Mixes easily! Uniform crystals resist caking! Ideal for high-analysis mixed goods! A fine direct application material!

AMMONIUM NITRATE—Phillips *66* Prilled Ammonium Nitrate contains 33% nitrogen. The small, coated prills or pellets resist caking . . . handle easily. Phillips *66* Prilled Ammonium Nitrate can be depended on for uniform, free-flowing properties and top-notch crop response.

NITROGEN SOLUTIONS—More N per dollar! Phillips *66* Nitrogen Solutions are well suited to the preparation of high-analysis fertilizers and the ammoniation of superphosphate. These three nitrogen solutions keep handling costs low . . . promote rapid, thorough curing!

ANHYDROUS AMMONIA—Tank car shipments of Anhydrous Ammonia (82% nitrogen) go out to Phillips contract customers from Phillips production facilities in the Texas Panhandle. Write our nearest district office for full information.

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To Make Hydrazine

Mathieson Chemical Co., Baltimore, is constructing a new plant at Lake Charles, La., for the production of hydrazine, a nitrogen compound used in weed killers, drugs and other chemical compounds. A certificate of necessity covering 90% of the cost has been received from the Government.

WASHINGTON

(Continued from Page 83)

Trade. Representatives of 12 to 15 nations attended the meeting, sponsored by the United Nations Economic & Social Council. The conference was concerned mostly with the means of improving world insecticide supplies and uses. The need for newer production facilities as well as the desirability of lifting insecticide trade barriers were keypoints of the discussion. Although the major emphasis was on DDT and Benzene Hexachloride, discussion was also had on other materials needed for both agricultural and public health uses. It is surprising to note that the Conference concluded that there is no world-wide shortage of any of these materials, at the present. While it is desirable to affect greater economies by more efficient production, nevertheless, it was concluded that there are generally sufficient quantities of the pesticide chemicals available for those countries in a position to use them.

The domestic DDT supply situation tightened suddenly during February and March due to the pressure of filling export requirements of this material. OIT had decreed a deadline of a major portion of exports to be available to leave the country by March 15th in order to have as small an impact on the domestic season as possible. This precipitated a buying flurry during these two months, and many industry spokesmen were surprised to see that the market was as tight as it was during March. In fact, one major producer who had previously had a low contract price of 44c took this occasion to raise the price to 48c. The market price is fairly well stabilized at 50c lb. in carload lots for spot shipments. It will be of interest to the industry, however, to see what happens during the period from April 1st until the heavy domestic consumer season gets under way. Many in the industry believe that stocks of finished materials and semi-processed materials are rather heavy in the field, and it will probably require the better part of April and May to fill the pipelines that normally would have been filled during the February-March period.

* * *

DPA announced that the nitrogen goal for 1955 was 2,930,000 short tons of contained nitrogen which represented an expansion of 1,390,000 tons over the capacity of the industry in 1950. This program provided for 500,000 tons of the production in addition to that under construction or planned as of the 1st of January, 1952.

Of the capacity needed in 1955, DPA said that 2,430,000 tons is already built or authorized. The balance would still be authorized in the early part of 1952.

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Typical Analysis	Hi-Solv 30	Hi-Solv 473
Distillation Range, °F	266—374	400—520
Specific Gravity	0.830—0.840	0.900—0.915
Color	Water White	Light Straw
Flash Point	80° F—TCC	180° F—COC

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customers know that when the PRESSURE IS ON, we load cars all night to get EMCOLS where they're needed . . . and get them there in time.

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Fire at Hyman Plant

Julius Hyman and Co., Denver, Colo., announce that a fire in their Rocky Mountain Arsenal plant has caused interruption in the production of Aldrin and Dieldrin. The fire was confined to the Dowtherm boilers, adjacent equipment and organic chemical stores. However the Dowtherm Unit is necessary in the operations of certain of the larger chemical facilities producing the insecticides.

Oklahoma Conference Held

The seventh annual Oklahoma Crops, Soils and Fertilizer Conference was held recently at Oklahoma A & M College, Stillwater. The meeting covered such topics as weed control in cultivated crops, breeding for disease resistance in grain crops, cotton, sorghums, and corn, fertilizer studies in corn, cotton, horticultural crops, and hay.

TECHNICAL BRIEFS

(*Continued from Page 95*)

son grass and quack grass ranged from 60 to 80 pounds per acre. Fall applications, when crops are out of the way and when moisture conditions are at an optimum appear most practical. TCA normally sterilizes the soil for a 30-to-60-day period. Studies are under way to determine the effect of various chemicals and cultural practices and combinations of the two root reserves. A study of the effect of maleic hydrazide on grasses is also included.

Treatments of potassium cyanate, rates of 8 and 12 pounds per acre: phenyl mercury acetate, rates of 10 and 15 ounces per acre; sodium trichloroacetate, rates 6, 8 and 12 pounds per acre, and maleic hydrazide, rates of 2, 4, and 8 pounds per acre, were applied to crabgrass in a bluegrass turf. Of these materials, potassium cyanate appeared most promising. Two applications of 8 pounds per acre applied at 10 day intervals killed 90% of the crabgrass with only slight injury to the bluegrass. Timeliness of application is important. Treatments are most effective when applied soon after emergence of crabgrass seedlings.

Most woody plants can be killed with 2,4-D applied as a dormant spray in oil. Oak and hickory sprouts, sumac, poison ivy and others were killed by spraying, applying the sprays during the months of January, February, March and April. Dilution of 1 pound of 2,4,5-T acid in 16 gallons of fuel oil appears to be most economical to use. The herbicide 2,4,5-T is more effective than 2,4-D or combination of the two. When 2,4,5-T is applied as a foliage spray, water as a diluent appears to be as effective as oil. Basal applications of 2,4,5-T have effectively killed small trees and shrubs. The treatment is most effective when used as a concentrated spray (1 quart of 2,4,5-T —40% material in 5 gallons of fuel oil) applied to the base of the plants.

—Oliver C. Lee, in 64th annual report, Purdue University, Lafayette, Ind.

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Model depicted here is the original paper bag "tubing" machine on which James Arkell obtained patents. This, and Arkell's original "bottomer" are the two basic machines after which all modern paper bag making machines have been patterned.

General view of the modern A. & S. Mobile plant where up to six plies of Kraft paper can be tubed in one operation with the outer ply colorfully printed on high speed 4-color presses.

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ARSENICAL

(*Continued from Page 53*)

jury. Some of the tests show that the concentrations of toxicant which gave no injury after one application showed definite signs of injury after two or three applications. The tomato plant, for example, showed no damage after one application of 0.25 lb. per 100 gallons, with no $Ca(OH)_2$ added as an injury inhibitor. Two successive applications of this concentration, however, produced severe burning of the lower leaves. A one percent dust in "Attaclay," on the other hand, required three applications to cause curling of leaves and slight burning of lower leaves, but two applications caused no injury. On pear trees, three successive applications of the one per cent dust gave no injury at all.

Because Compound A42 (Arsenomethane As-1 Disulfide) exhibited considerable toxicity to the test insects which were available in the locality of testing, and because of the limitations of local phytotoxicity tests, further testing on insects infesting cotton, potatoes, tomatoes and other crops reasonably tolerant to arsenicals is warranted. The effect of Compound A42 on wireworms and nematodes will also be studied.

TABLE IV
Minimum Concentration Showing Plant Injury

	Lbs./100 gals. Spray			Per cent Dust	
CROP	CONC.	Corrective $Ca(OH)_2$	Applic. No. of	Concentration	Applic. No. of
Potato	0.75	—	1	3.0 in Attaclay	1
Tomato	0.25	—	3	1.0 in Attaclay	3
	1.00	4.0	1	10.0 in Attaclay	1
Pepper	0.50	—	3	—	—
	1.00	4.0	1	—	—
Cucumber	0.50	—	1	1.0	1
Corn	0.05	—	1	0.5 in Attaclay	1
	0.25	0.5	1	1.0 in $Ca(OH)_2$	1
Bean	0.075	—	1	0.8 in Attaclay	1
Peach	0.025	—	1	0.5 in Attaclay	1
	—	—	—	—	—
	0.05*	—	1	—	—
Pear	0.075*	—	1	—	—
	0.25	0.50	1	—	—
Apple	0.075	—	2	0.5 in Attaclay	3
	0.25	1.0	1	5.0 in $Ca(OH)_2$	1

*Decreased solubility in water obtained from a water-washing process.

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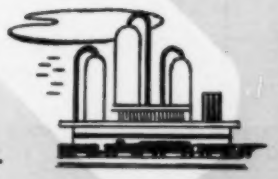

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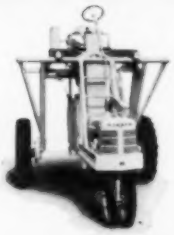

CHECK THESE CROP-SAVING FEATURES

- **Pump capacity up to 20 g.p.m.**
- **Pump pressures up to 800 lbs.**
- **Crop clearance—7 feet.**
- **Mechanical agitation in 275-gal. tank.**
- **Welded tubular construction.**
- **Powered by 24 h.p. International.**

WARREN DIVISION—AMERICAN STEEL DREDGE CO. INC.
DEPT. AC—FORT WAYNE, INDIANA

The originator of Compound A42, the American Smelting and Refining Company, will grant licenses, on a non-exclusive basis, to manufacturers who wish to market it, providing, of course, that further evaluation gives conclusive evidence that this new organic arsenical is ready to take its place among tested and accepted economic poisons.

Arrangements for a broader testing program, which will define the scope and limitations of use of Compound A42 will be made by Theodore Riedeburg Associates, 415 Lexington Avenue, New York 17, New York, who, as consultants to American Smelting & Refining Company, are handling all correspondence and sample requests for the 1952 season. Limited quantities of technical Compound A42 and a wettable powder formulation will be made available to the insecticide industry and to Federal and State experiment stations.

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(3) Walker, H. W. and Mills, J. E., Chemical Warfare Service Boll Weevil Investigation, *Ind. Eng. Chem.* 19: 703 (1927).

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To Int. Paper Co. Board

The board of directors of International Paper Company has announced the election of Harvey P. Hood and John M. Kingsley to the board to fill existing vacancies.

Mr. Hood, a native of Massachusetts, is president of H. P. Hood & Sons of Boston, a director of the Boston and Maine Railroad, the New England Telephone and Telegraph Company and the Federal Reserve Bank of Boston. He is also a Trustee of Dartmouth College and the Children's Hospital of Boston and a member of the Board of Overseers of the Boys' Clubs of Boston.

Mr. John M. Kingsley, a resident of Greenwich, Connecticut, is associated with Henry Phipps Estates. He has served as the financial officer of the estate for the past ten years, and is a director of the Bessemer Trust Company and a trustee of the Greenwich Hospital.

Takes Soil Fumigant Post

Richard Barton has been named to the position of technical adviser and sales manager for soil fumigants and agricultural chemical specialties by Innis, Speiden and Co., New York.

•

Pacific Fert. Chm. Retires

James T. Phillips, chairman of the board of Pacific Chemical & Fertilizer Co., Honolulu, retired recently after twenty years with the firm.

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QUALITY CHEMICALS FOR AGRICULTURE!

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Technical Esters .....of 2,4-D
..... of 2,4,5-T
Low Volatile Esters .....of 2,4-D
..... of 2,4,5-T

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Complete formulations of

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- Parathion
- DDT
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- Lindane
- Aldrin
- 2,4-D
- 2,4,5-T

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What goes into BAGPAK service to make it so dependable?

Pulp wood from I.P.'s own woodlands, converted into kraft at I.P.'s own paper mills, and made into bags in I.P.'s own bag plants. Practically everything that goes into the manufacture of a Bagpak bag is furnished by the facilities of International Paper.

"you can bank on Bagpak!"

Bagpak has been manufacturing multiwall paper bags since 1928 — makes all kinds of multiwalls, in basis weights to meet any strength required, in a complete size range, without printing or with "non-smear" printing up to four colors.

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Five different I.P. Mills supply bag kraft — not only Natural but also Colored Kraft Paper, as well as Polyethylene Liners, Asphalt Laminated Kraft and Wet Strength Paper. Each bag mill is located on two or more different railroads. Two traffic departments assure prompt delivery.

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for heavy duty multiwall bags: — bags, bag closing materials, car liner, palletized shipments when required, packaging machines and scales — all from one source of supply! Staffs of experts help you with bag designs and packaging problems.

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All these go into the business of providing you with a dependable supply of multiwall paper bags. For the answer to any particular multiwall bag problem, write to:

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International Paper COMPANY

BAGPAK DIVISION

Mathieson Purchases Plant

The Mathieson Chemical Co., Baltimore, recently acquired the fertilizer division of the Tovrea Land and Cattle Co., near Phoenix, Arizona. The acquisition includes a plant for dry mixing of high analysis fertilizer and insecticides and a wide sales distribution organization in the southwest and on the pacific coast.

RODENTICIDES

(*Continued from Page 48*)

more effective than "Dicumarol" in causing fatal hemorrhage in the rat. This observation prompted Professor Link to make the notation that this compound might be a good rat poison. In the April 1944 issue of the *Journal of Biological Chemistry*, this particular compound was listed as the forty second one out of over one hundred compounds reported. Originally it was referred to as "Compound 42;" more recently it is known by its generic name, warfarin. It has the chemical name of 3 (alpha acetonylbenzyl)-4-hydroxycoumarin. Warfarin is covered by a patent issued in 1947 to Mark A. Stahmann, Myoshi Ikawa, and Karl Paul Link. This patent has been assigned to the Wisconsin Alumni Research Foundation, Madison, Wisconsin.

In December 1948, a meeting was held in Prof. Link's office to review the rodenticide situation to date and to formulate a program of investigation. The data available at that time were indeed impressive and appeared extremely promising. However, it was also fully recognized that much work remained to be done.

In the planning of this research program the phsyiological action of this particular group of compounds had to be considered. From past experience it was agreed that this action was dependent upon three things. 1. For the most part, compounds of this class are extremely insoluble, hence, necessarily increasing the absorption time. 2. Certain definite requisites in time must be allowed for the production of the initial stages of the hemmorrhagic condition. 3. An additional period of time is required for the necessary capillary damage to take place to precipitate the fatal hemorrhage.

Shortly after the tentative research program was initiated, it was noted that warfarin was only mildly effective as a single dose rodenticide. Obviously, these initial experiments proved that a single dose technique did not permit sufficient time to allow the normal sequence of these physiological phenomena to pursue their natural course. The deaths that did occur apparently were among the exceptions.

Hence, the use of warfarin as an anticoagulant rodenticide was markedly changed. From a single dose basis of a relatively low dosage, the picture was changed to one of employing a multiple dose technique of markedly smaller doses. In the course of these experiments it became quite obvious that warfarin had little or no odor or taste as well as causing no violent reactions. This indicated that

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bait shyness or self-education did not develop. For the first three to four days, in normal course of events, the food consumption appeared normal. Beyond the fourth day, the total food consumption dropped rather markedly until death.

How Rats React

AT this point it might be advisable to point out the reactions observed on rats receiving lethal doses of warfarin. For the first two to three days, no marked changes in appearance or activity can be noted. The first indication that internal hemorrhage is taking place is evidenced by the bleaching of the skin of the albino rat. This is discernible in those areas relatively free of hair, such as the ears and the feet. This observation is usually made on the third or fourth day and persists until death. Frequently, beginning on the third or fourth day, signs of subcutaneous hemorrhage are also noted. This is observed under the skin of the feet and, in the male rat, in the scrotum. Concomitant with these evidences of internal hemorrhage, quite frequently the pink eyes of the albino rat become quite red due to the internal hemorrhage in the eye. At this stage the rats are content to remain as quiet as possible. The animal walks with a slow and measured shuffling gait with a tendency to drag the hind feet slightly.

Within 24 hours of death, the rat lies on its side with no perceptible movement other than breathing. Finally the rat dies from suffocation. As hemorrhages occurs within the body the blood leaves the vascular system and stagnates. As each tissue is dependent upon the oxygen carried by the blood stream, a diminution in the blood volume results in a marked decrease in oxygen. Thus the animal actually dies of tissue suffocation.

Since the vascular system has no sensory connections, there is no preliminary warning as to when hemorrhage occurs and hence no pain. Consequently, there are no outward signs of violent reactions due to the poison, which would "educate" other rats to develop bait shyness. Furthermore, since there is no physical association between the bait and the hemorrhagic condition the stricken rat also does not develop bait shyness.

Upon autopsy certain well defined sites of internal hemorrhage can be noted. These areas are usually confined to the urogenital system, the heart, the lungs, and less frequently, the gastrointestinal tract. Unless the rat has been injured, little or no blood is observed externally. Occasionally a small bloody exudate is noticed around the nose and in the urine.

It was indicated previously that the commonly used rodenticides had one or more marked disadvantages. It is impossible to compare each of these with warfarin in a short period of time, but a comparison can be made in a general way by indicating the known advantages of warfarin. These are listed as follows:

1. Warfarin is not a rapid actor and does not produce acute symptoms of poisoning. Usually about a week is required to note a marked

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S-W 50-50 DDT Wettable
S-W Dimite (Miticide)
S-W Flo-Mulsion (Dormant oil spray)
S-W Karbam Black (Ferbam)
S-W Karbam White (Ziram)
S-W Mulsoid Sulfur (Micronized sulfur)
S-W Sulfix Sulfur (Microfine sulfur)
S-W Safe-N-Lead (Zinc safener)
S-W Spralastic (Spreader and sticker)
S-W Spred-Rite (Spreader and sticker)
S-W Summer Mulsion (Summer oil spray)
S-W Step Drop (Naphthalene acetic acid)

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reduction in population. Since there are no acute symptoms of poisoning, bait shyness is not developed and rats and mice continue to eat the bait in an unconcerned manner.

2. It is odorless and tasteless obviating the necessity of prebaiting and again avoiding the development of bait shyness.

3. Warfarin is effective in extremely low dosages. It is used commercially at a concentration of 0.025% or 1 part in 4000. Where one pound of red squill is estimated to give a 50% kill in approximately 5000 rats, an equivalent amount of warfarin approaches 100% kill in approximately 40,000 to 80,000 rats. The latter figure is based on a kill of 10 to 20 rats per pound of finished bait as observed under practical conditions.

4. Warfarin does not cause the development of a tolerance. In fact one or two days may elapse between dosages.

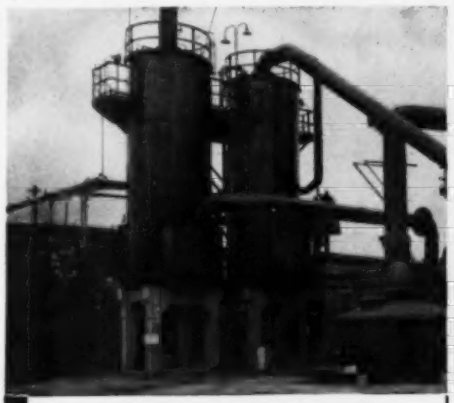
5. Apparently there is no sex or age difference. There may be a small strain or species difference, but it is not sufficiently significant to be of any concern.

6. Warfarin at the same concentration as used for rats, namely, .025%, is also effective against the mouse. The latter, due to its extreme shyness and peculiar eating habits, is extremely hard to poison. Warfarin has excelled all other mouse poisons in effectiveness.

7. Since warfarin is a definite chemical entity there is no variation in effectiveness from one batch to another.

8. Warfarin when used at the recommended dose and in dry cereal baits is relatively non-toxic to pets, farm animals, poultry and man. It is a poison and should be treated with respect as it can kill other animals if misused. Protected bait stations are highly recommended. Laboratory experiments have shown that cats, dogs, rabbits, chickens, mink and pigs can be killed with warfarin. However, the dosages and the time required are greater than those for the rat or the mouse. Considerable variation exists between the various animals as respects dosage and time. Chickens appear to be quite resistant, whereas pigs may be rather sensitive. Since repeated doses are required, the possibility of poisoning other animals is rather remote if proper precautions are taken. In this respect warfarin equals red squill in safety.

9. Accidental poisoning can be counteracted by vitamin K and blood transfusion in a manner similar to that employed in overdoses of "Dicumarol." It is true that if the hemorrhaging is extremely severe, the threshold of effectiveness of such an antidote procedure is exceeded. In cases of starting hemorrhage it is recommended that two 72 mg. ampules of menadione be administered orally. With more severe hemorrhaging this dosage should be repeated together with a blood transfusion. Some practitioners also recommend the administration of vitamin K by both oral and parenteral routs. However, due to its relative safety, no human



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deaths have occurred and only a few cases of minor poisonings are known. There have been a number of reports of the death of cats, dogs, and pigs, but these have been relatively few and in many cases strongly questioned as to whether warfarin actually was the causative factor. This is particularly significant when it is considered that enough warfarin products have been sold to produce several million pounds of warfarin finished bait.

10. Although the multiple dose technique, as required in the use of warfarin, is a new approach to rodent control, it has proved extremely effective. Its success is enhanced by the fact that rats and mice as a general rule confine their activities to relatively small areas close to their nests. Such an arrangement is ideal for a multiple dose technique.

From the above it is very obvious that much research work had been conducted on warfarin to permit its introduction on the market. This work covered several years and the cooperation of a number of laboratories and government agencies. In addition to the continuation of the work by Professor Link's group, other projects were conducted in the laboratories of the Wisconsin Alumni Research Foundation; the laboratories of S. B. Penick & Co. and Prentiss Drug & Chemical Co., Inc., licensees under the Foundation's warfarin patents; the Fish and Wildlife Service of the U. S. Department of the Interior; the Communicable Disease Center of the U. S. Public Health Service; and the U. S. Department of Agriculture.

Up to the present time, packaged warfarin consumer products have been made available on the market by approximately 180 manufacturers. These products are of two types. One is a warfarin concentrate usually containing 0.5% warfarin designed to be mixed with bait material on the basis of 1 part of concentrate to 19 parts of bait, achieving a final concentration of 0.025% warfarin. The other product is a warfarin finished bait, ready to use, containing 0.025% warfarin. In all cases, the finished bait consists primarily of a single cereal grain or combinations of cereal grains. Cracked and coarsely ground grains are used.

During the past year, an educational campaign has been in progress to make the public aware of the rodent menace with which we are confronted and to give instructions in the proper use of warfarin. This educational program has been directed to county agents, home demonstration agents, extension directors and other extension workers and to Vocational Agricultural Teachers and Veteran Trainers *throughout the United States*. In addition, publicity has been given warfarin by means of educational articles in newspapers and magazines with particular emphasis on agricultural journals.

Although much was known about warfarin before it was made generally available, a number of research problems still remain. Since warfarin baits must be available to the rodent for considerable periods of

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Du Pont EPN 300 Insecticide, which was first introduced as a miticide for apples and other fruits, has now been found effective for control of various species of mites and insects on deciduous fruits, citrus, corn, tomatoes, onions and dry beans.

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EPN is being officially recommended in the major peach areas of the country for control of most of the important peach insects, especially plum curculio. Tests by Du Pont and other investigators during the past season have confirmed previous indications that EPN would give effective control of various mites and insects on many other crops.

New Research

The following list shows insects on which 1951 tests were especially successful, and shows some of the states where the principal EPN tests were made:

Citrus red mite, orange mite and fruit-tree leaf roller on citrus—*California*

Peach-tree borer—*Indiana, North Carolina, South Carolina, Georgia, New York*

Lesser peach-tree borer—*Ohio, New York*

Lecanium scale crawlers and peach cottony scale crawlers—*New York*

Bud moth on prunes—*California*

Grape-berry moth—*New York, Ohio, Pennsylvania*

Codling moth on apples—*Indiana, Virginia, New York*

Codling moth on pears and walnuts—*California*

Walnut aphid on walnuts—*California*

European corn borer—*Illinois, Minnesota, Ohio, Wisconsin*

Mexican bean beetle—*Delaware, New York*

Potato aphid on tomatoes—*Florida, New York*

Two-spotted mite on beans—*California, New York*

Russet mite on tomatoes—*Ohio, Texas*

EPN is listed in the official recommendations of 10 states plus the Western Cooperative Spray Conference and eight California counties for control of various mites and insects on peaches, pears, apples, plums, prunes, grapes, apricots, cherries, nectarines, walnuts and almonds. It is also recommended for mite control on apples in seven states and two California counties.

Dust Mixtures and Low-Volume Sprays

Dust mixtures made with Du Pont EPN 300 Insecticide have proved effective in experiments against various cotton insects, European corn borer and certain other insects on field crops. Experimental emulsifiable formulations of EPN have been tested in low-volume sprays for control of grasshoppers, sugar-beet webworm, European corn borer, and certain cotton insects.

EPN Insecticide is available from Du Pont as a wettable powder. For more detailed information, write Du Pont, Grasselli Chemicals Department, Wilmington, Delaware.

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time, the continued acceptability of such baits is extremely important. Factors such as insect infestation, molding, rancidity, etc., all lend themselves to a reduced acceptance. Furthermore, more work is required on the control of field rodents other than rats and mice. Additional work is also necessary on the toxicity of warfarin to other species of animals, as well as improvements in the methods of assay. All of these projects are in progress now.

In conclusion, it should be pointed out that within one year's time, warfarin has proved to be the most effective and safest rodenticide known to man. If properly used, it should reduce the rodent population of the world to an extent never achieved or hoped for before. This achievement should be markedly reflected in the economics of this country as well as in the health of the people, particularly in tropical regions. This is significant when one considers that there are approximately 150,000,000 rats in the United States—one for every person. It is estimated that it costs us $2.00 per year to feed each rat and that the damage done runs between one and ten billion dollars. This yearly destruction of food is equivalent to that raised on approximately 200,000 farms. I think you will agree that these figures are staggering. From results obtained to date, it is definitely indicated that warfarin is the first rodenticide that can materially minimize this waste.

FUNGI RESEARCH

(*Continued from Page 56*)

They, thereby, block essential cell functions. Unfortunately there is very little good information as to exactly which biochemical processes are blocked, so no recommendations can be made as to exactly which types of chemicals could be expected to be most effective.

The ability to chelate or otherwise react with metallic ions has been proposed as a possible explanation for bacteriostasis and fungistasis (25) in some compounds. The 8-hydroxy quinoline and organic sulfur compounds should remove copper, zinc, cobalt or other metals from cell protoplasts where they serve as coenzymes to a protein. Unfortunately for this hypothesis, the chelated compounds are potent fungicides in their own right, so judgment must be reserved until additional data are available (9, 19).

Ever since Woods (23) noted the analogy between sulfonamide bacteriostats and para-aminobenzoic acid, evidence has been accumulating that drugs may antagonize essential metabolites. These two materials are similar in molecular size 6.7 x 2.3 ängstrom units) and each has an amino group which would enter into similar reactions (17). However, the carboxyl group on p-aminobenzoic acid could react to complete the synthesis of necessary metabolites, whereas the sulfonamide grouping might not. Thus the drug would block a normal activity of the cell by preempting the

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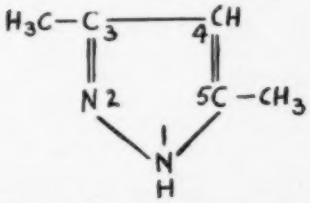
position of an essential intermediate. If the essential reactant (PABA, in this case) is supplied abundantly, the microorganism can escape the ill effects that would normally be expected from a lethal dosage of antagonistic drug. Many other metabolite-antimetabolite analogs are known to antagonize each other in cell reactions (24); so this hypothesis can be accepted with reasonable confidence. The chief difficulty in exploiting this technique is that so little information is available on the precise metabolites that are vital in cell activities of fungi.

The surface active compounds emulsify or otherwise destroy delicate membranes of the cell walls in bacteria and fungi. They can, therefore, be used as disinfectants, but they are so water-soluble that they fail to protect surfaces of fruit and foliage during rainstorms. The conventional fungicide is a persistent, fairly insoluble material that gradually releases its toxicant whenever conditions favor the growth of the fungus.

Improving The Basic Nucleus

AFTER a reactive nucleus has been discovered, it can be perfected by adding substituents which serve as toxaphores or improve cell penetration. Much of this substitution must be done blindly and the chemist depends upon bioassays to guide him step by step in improving the composition. A few examples may serve to illustrate this technique.

The five membered pyrazole nucleus is relatively inactive (14)



However, by substituting a reactive grouping in the 4-position, it may be improved. A nitroso group is much more serviceable than a nitro, amino, or methyl group, since 4-nitroso pyrazole is about 1,000 times as active as the unsubstituted compound. Its maximum activity is not realized until an aryl group is substituted on the 1-nitrogen. A naphthyl ring in this position is superior to a phenyl group and a methyl group is ineffective. The 1-phenyl-4-nitrosophyrazole structure may be further improved by halogenation of the phenyl ring. A p-chloro, o-chloro, m-chloro, or p-methyl group will double the efficiency of the molecule. The substitution of a longer alkyl chain, aryl or similar large group in the para position, results in a less active compound. Substituents in the 3- and 5- positions are relatively inert, except that long carbon chains may reduce activity.

No one knows exactly why these very definite and precise relations hold. The very fact that substitution in the 1- and 4- positions improves fungitoxicity geometrically, suggests that they operate independently of each other in the fungus cell. It has been assumed, without full proof, that the 4-nitroso group is a toxophore, and the substituted aryl

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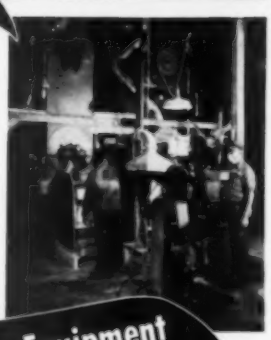

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INTIMATE BLENDING

318

group in the 1-position influences penetration. The nitroso group improves the fungitoxicity of so many compounds such as phthalimidine (8) that there is good reason to suspect that it is a toxic radicle.

The quinones class contains many good fungicides, provided the positions ortho to the carbonyl group are not blocked. The available data have been reviewed elsewhere recently (13) and need not be discussed in detail. The naphthoquinones are more potent than benzoquinones or 9,10-phenanthraquinone which are more active than anthraquinone or the higher homologues of the series. Halogenation improves fungitoxicity and saftens them for use on plants, with chlorine being more effective than bromine or iodine. The substitution of hydroxyl or methoxyl groups increases phytotoxicity and bacteriostatic activity. If all positions ortho to the carbonyl groups are substituted with alkyl or similar stable groups, the molecule becomes relatively non-toxic. This changes the oxidative potentials and would prevent addition reactions with sulfhydryl groups at the double bonds in the quinoid structure.

The quinones are strong oxidants and will inactivate various enzymes such as amylase and carboxylase. Since there are many naturally occurring quinones in fungi, they may also serve as antimetabolites. So far, however, the mechanism of their action has not been established.

The glyoxalidine (imidazoline) nucleus is activated by substitution of an alkyl group in the 2-position (22). Both fungitoxicity and injury to plants increase with chain length up to 11 carbon atoms. Phytotoxicity declines, while fungitoxicity continues to improve up to 17 carbon atoms. Beyond 17 carbon atoms, both fungitoxicity and phytotoxicity decline. Under these conditions the 17-carbon atom compound (heptadecyl glyoxalidine) was chosen for commercial development. Only minor difficulties have been encountered from plant injury.

The reason for the side chain effects has not been established, but the evidence suggests that this is due

to differential penetration, i.e., lipoid solubilization effect. The penetration of plant tissue is different from penetration of the fungus, because of innate differences in the cell walls of the two. Further evidence is needed to establish this hypothesis.

The dithiocarbamates have been among the more successful organic fungicides developed during recent years. In general, the dimethyl dithiocarbamates are better fungicides than ethyl or butyl derivatives (3, 6). The iron, lead and zinc salts are safer to use on plants than the sodium, copper, silver or mercury compounds. Ferric dimethyl dithiocarbamate has been used extensively for control of tomato anthracnose and apple rust (18) while the zinc salt has been used for tomato and cucurbit diseases. The zinc and disodium ethylenebisdithiocarbamates have proved very effective in controlling late blight of potatoes.

Need for Fundamental Information

ALTHOUGH considerable information is available on the relation of chemical structure to biological activity, as indicated in this brief review, it is obvious that we do not have much reliable information on how the fungicides operate. Until complete information is obtained on the mechanism of spore penetration and type of cell metabolites or enzymes inactivated, it will not be possible to explain the information at hand or to predict what will be needed for effective action by other chemicals.

The difficulties inherent to securing such data possibly can be illustrated by research conducted on sulfur fungicides at Boyce Thompson Institute by McCallan and Wilcoxon. Sulfur was considered a relatively poor fungicide, so various theories had been advanced to explain the action of lime-sulfur and wettable sulfurs. After disproving the pentathionic acid theory, McCallan and Wilcoxon (11) proceeded to demonstrate that sulfur volatilizes from spray deposits and is reduced to hydrogen sulfide by germinating spores or other living cells.

The spores are very sensitive to hydrogen sulfide, so this was considered to be the lethal agent, probably produced by dehydrosulfonation of glutathione or other proteins and enzymes in the presence of readily available sulfur. The hypothesis gained substantial support by evidence that sulfur-sensitive fungi such as *Glomerella cingulata* produce hydrogen sulfide readily while some sulfur-tolerant fungi such as *Macrosporium sarcinaeforme* do not produce it.

The hydrogen sulfide theory is being currently reviewed by Miller, McCallan and Weed (10, 15) who have traced the fate of sulfur from the time it is applied to the leaf until the fungus spore is killed by using radioactive S^{35}. The first theory to fall is that hydrogen sulfide is released from sulfhydryl bearing proteins. The sulfur molecule in the gaseous phase penetrates the spore, almost immediately picks up two atoms of hydrogen and is released from the spore. If S^{35} is used, the

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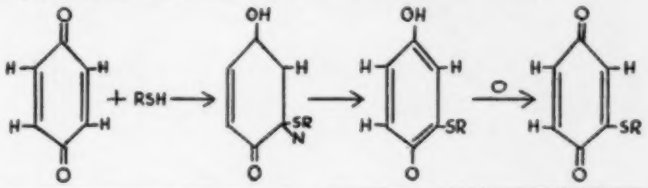
The rate of sulfur penetration and escape of hydrogen sulfide from the cell is astonishing. Sulfur to the extent of 4 per cent of the fungus spore weight may be reduced within an hour. When one considers that over 85 per cent of the spore is water, the ratio of sulfur reduced to solid spore constituents is truly remarkable.

The second concept to be questioned is the low toxicity of sulfur. By preparation of colloidal suspensions McCallan and Miller have demonstrated that most of the species of fungi tested are more susceptible to sulfur than to hydrogen sulfide. Finally, they have shown that some species of fungi which reduce sulfur are not injured by hydrogen sulfide; so hydrogen sulfide is not the sole cause of sulfur toxicity.

The studies on fungicides labeled with radioactive atoms have permitted accurate measurements of the penetration into spores and mycelium for the first time. The phenomenal rate at which sulfur is sorbed and released is typical. Spores placed in a suspension containing only 2 p.p.m of fungicide may contain 10,000 to 20,000 p.p.m. of its body weight within a few minutes. It is obvious that good fungicides are either absorbed or adsorbed in overwhelming quantities before the spore has an opportunity to recover. It follows logically that good fungicides must be capable of rapid penetration if they are to make effective use of the toxicant radicles on their molecules. The importance of this mechanism and the effects of chemical constitution upon penetration has been best demonstrated by Fieser *et al.* (2) for *Plasmodium*.

There is fair evidence that fungitoxicants affect either the sulfhydryl-bearing enzymes or coenzymes. For example, the better quinone fungicides do inactivate carboxylase (7) approximately in the same ratio as they inhibit spore germination. They also affect cholinesterase and pancreatic lipase, but there are some biologically active quinones that did not affect sulfhydryl-bearing enzymes by the technique employed by Hoffman-Ostenhof *et al.* (4). It is known that quinones form addition products with sulfhydryl compounds and probably undergo reduction followed by oxidation by the following series of reaction:



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The addition or substitution of any mercaptan reduces the potency of quinone fungicides and bacteriostats. However, the substitution of other groups ortho to the carbonyl will also suppress or inhibit activity, thereby suggesting that this reaction is important. So far no one has identified the reaction products that occur naturally in the fungus cell, so full proof is not yet available.

Improving Effectiveness of Fungicidal Compositions

AFTER a fungicidal nucleus has been discovered, and improved to maximum effectiveness by proper substitution, there still remains the problem of formulating it so it will operate to best advantage. Consideration will be given only to the protection of foliage and fruit surfaces, since practically all agricultural fungicides are deposited as a thin protective layer before the tissues become infected. There are only three exceptions to this type of application: a few fungicides such as phenyl mercury compounds, quaternary ammonium compound, lime sulfur and dichloronaphthoquinone will eradicate apple scab infection on foliage, chemotherapeutants may operate internally and the powdery mildews whose mycelium remains conspicuously on the leaf surface may be eradicated by direct contact after establishing haustoria in the epidermal cells.

The surface-protecting fungicides must be distributed so each susceptible unit of area on foliage and fruit will be protected. The material must adhere to that surface during wind and rain, not be decomposed by sunlight, oxidation or plant secretions and must release toxicants in sufficient quantity to destroy any fungus spore that lands in that protection zone and begins to germinate. If a fungus hypha grew several inches across the surface before it found a stomata to enter, or a place to penetrate the epidermal cell, very irregular distribution of chemical would suffice. Such is not the case, however, since hyphae usually penetrate the surface within 20 to 200 microns from the spore. The objective is to deposit particles so thinly they will not interfere with growth or metabolism in leaf and fruit, but will be encountered by the fungus.

It is obvious that the fungicide must not be too coarse, because exceedingly heavy doses would be required to assure deposition of one or more particles at every locus where spores may land. This increases the opportunity for injuring the crop, reduces the chance for encounter with the fungus, suppresses the rate at which toxicant could be released per unit weight of material and increases the possibility of dislodgement by raindrops and wind.

Data have been available on the effect of particle size in sulfur for several years. The general conclusion has been reached that the smaller particles are more effective, so sulfur should be ground as finely as possible. Micronizing and other devices were used to reduce particles to a diameter of less than 5 microns. This entire subject was reevaluated by Burchfield and McNew (1, 12) for an organic fungicide. The same general rules

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held, since efficiency of the fungicide improved as particle size was decreased. By employing careful analytical procedures, relatively homogeneous preparations were secured from a common source (Fig. 1) and used to determine the actual deposit of each class of particles on a unit of tomato leaf surface at the time of exposure to *Alternaria solani*.

By taking advantage of the newer techniques in evaluating fungicidal effectiveness, it is possible to determine the number of particles required to attain a given degree of disease control. The relation of each spore to particles of different sizes that are adequate to provide 95 per cent protection has been reconstructed to scale in Fig. 2 (Pg. 56). These deposits would be obtained from using 64, 89, 157, 445, 870 and 2,200 parts of dichloronaphthoquinone per million of water in the spray. The number of particles per square centimeter was 95,600, 21,500, 2,700, 596 and 118 respectively, representing deposits of 0.28, 0.35, 0.48, 0.85, 2.40, 4.70 and 12.0 micrograms per square centimeter.

The significant feature in these data is the change in surface areas of chemical exposed to provide 95 per cent disease control. The maximum efficiency of fungicide per unit of surface exposed is obtained by particles 3 to 5μ in radius. If particles are larger than this, more area must be exposed because so much of the chemical is piled up on one spot. If smaller particles are used, more surface is exposed because so many particles are required to destroy each spore (see Fig. 2, Pg. 56).

These fundamental relationships are not purely academic. They are among the more practical things in the world. If too much area is exposed, the chemical deposit is more subject to oxidation, destruction by light and erosion by water. This was shown to be true for this chemical, because plants sprayed with different sized particles and left in the greenhouse showed loss of 79, 79, 33, 28, 100, 100 and 100 per cent of their protection within a week where the particles averaged 0.45, 0.81, 1.48, 3.57, 8.36, 13.8 and 24.5μ in radius.

The objective in grinding dichloronaphthoquinone is to obtain as many particles as possible in the range of 3 to 5μ. To grind them smaller destroys their persistence, to leave them larger is to lose fungicidal efficiency.

Data such as these are invaluable in preparing a commercial product. "Phygon" is one of the more effective fungicides and will control apple scab, late blight of potatoes, tomato anthracnose and many other plant diseases at dosages of one pound in 100 gallons of spray. Like so many organic compounds, the high unit cost of manufacturing leaves very little margin when competing with cheaper materials such as Bordeaux mixture or wettable sulfur. By regulating particle size to the optimum range dictated by these data it was possible to double its efficiency and make it competitive with the cheaper spray materials.

Many other problems of formulation must also be studied. Insoluble particles must be rendered wettable by proper use of surface active agents, but excess materials must be avoided so the particles will not wash off the leaves during rainstorms. The ideal method of application would be to dissolve the material in a persistent solvent and apply it as an emulsion, but such materials usually are injurious to plants.

Adhesives have been used to prevent the dislodgement of fungicides. They may increase the persistence of particles but, if so, they usually render the material less available to destroy the fungus spore. The good fungicides must release toxicant particularly during rainstorms and moderate redistribution should be considered highly beneficial. It permits splashing to unprotected areas such as new foliage that develops after sprays are applied. Some very sensitive fungi such as the downy mildew of hops may be controlled fairly well by use of cord impregnated with fungicides to tie up runners.

Recapitulation

THIS brief review points out the very great benefits that are to be obtained from applying fundamental knowledge wisely to practical research programs. It reduces the cost of research and improves the effectiveness of new products. The only difficulty is that the necessary fundamental knowledge is often lacking. More information is needed on the nature of the cell wall in plants and fungi and the biochemistry and physiology of plant parasites. A concentrated effort is being made to learn why chemical configuration affects fungitoxicity, what mechanisms are involved in penetration, and which vital cell functions are disrupted. It is an expensive type of research, both from the viewpoint of time and money expected, but in the long run it will be the cheapest path toward attaining a perfection in fungicides which is almost impossible by empirical testing alone.

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RESIDUE PROBLEMS

(*Continued from Page 71*)

Golden Rule, no additional rules, regulations, or laws would be required. But one needs only to observe the conduct of his friends, his neighbors, and his associates to determine for himself that some form of regulation is necessary and desirable. The plain fact is that we do need some sort of rules and regulations governing practically all phases of our daily activities. Pest control is no exception. Past history tells us that without regulations, some individuals will violate the accepted standards of safety.

By and large, pesticide users do not object to reasonable regulation of their activities through legislation or otherwise, but as typical Americans, they are not ready to accept dictatorship in any manner, shape, or form. In reality, the question of residue regulation boils down to one of how much legislation is reasonable, safe, sound, and necessary. At the present time we have two rather broad federal statutes and over 40 state laws regulating pesticide usage, and these appear to afford the public a very large and perhaps adequate degree of protection.

The Federal Food, Drug, and Cosmetic Act of 1938 in effect regulates the use of pesticides by prohibiting the movement in interstate commerce of adulterated and misbranded foods. The spray residue provisions of the Act are contained in Sections 402 and 406. Full import of the provisions can be gained only by considering these Sections together.

Considering both sections of the Act, it would appear that the Food and Drug Administration has ample authority to protect the public from dangerous pesticide residues on foods. If, as provided in Sec. 406, the administrator finds that a poisonous or deleterious substance is required in the production of a food or that it cannot be avoided by good manufacturing

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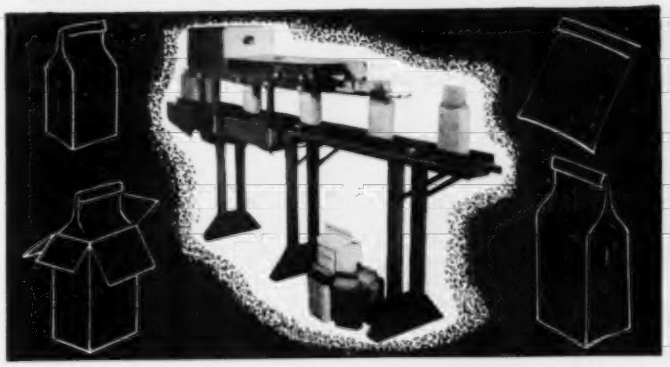

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practices, he is obliged to promulgate regulations limiting the quantity therein or thereon—in other words, establish a tolerance. On the other hand, if he finds such a substance is not necessary in production or could be eliminated, proceedings can be instituted under Section 402.

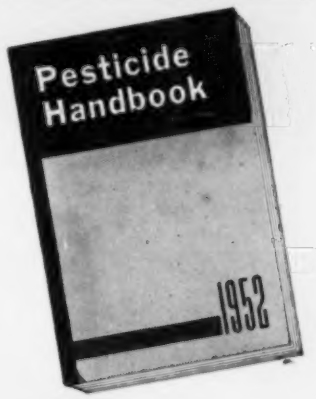
Unfortunately, the Food and Drug Administration, in the 13 years the statute above has been in effect, has seen fit to promulgate tolerance regulations in only one instance. In 1944, tolerances for fluorine on apples and pears were established by a regulation. Even these tolerances were subsequently invalidated by court action, so that at the present time there are no official tolerances on the books. However, we do have two administrative tolerances which limit residues of arsenic and lead on apples and pears to 7 parts per million. Also, more or less by mutual consent, there is a similar tolerance for DDT. The latter is based upon the Commissioner's statement that the Food and Drug Administration probably would not take action against apples or pears bearing less than 7 p.p.m. of DDT.

As you are all aware, about two years ago the Food and Drug Administration opened lengthy hearings for the purpose of taking evidence upon which to establish tolerances for all of the pesticidal materials which the administrator may consider necessary for use in the production of fresh fruits and vegetables. These hearings were concluded over a year ago, but to date the proposed tolerances have not been released.

As things now stand, I see no possibility of our having official tolerances established in time to apply to the 1952 crops. When the tentative tolerances are released by the Food and Drug Administration, interested parties (insecticide companies, fruit growers, food processors, and others) will have 90 days in which to file objections to the proposed regulations, after which the Food and Drug administrative personnel will undoubtedly take considerable time studying the exceptions and reviewing pertinent data presented at the original hearings before formulating and releasing the final and official residue-tolerance regulations. Considering these inevitable lapses of time that must intervene, I do not believe it is possible that we will have official tolerances established before next fall, and it may be months later than that.

We are prone to become somewhat impatient, but I think if we consider calmly the immensity of the job we will find in our hearts considerable sympathy for those officials charged with the responsibility of preparing the regulations. Bear in mind these public servants must, in considering each fruit and each insecticide, review hundreds of pages of printed testimony and literally thousands of pages of printed material contained in exhibits that were presented by witnesses who appeared at the hearings. In each instance they must decide what materials are necessary for use in the production of each crop and the amount of each such chemical that might endanger the public health. They must also give some thought to how each proposed regulation might be enforced.

The U. S. Department of Agriculture does not establish tolerances; however, the Federal Insecticide, Fungicide, and Rodenticide Act of 1947 authorizes the Secretary of Agriculture to regulate the movement and use of economic poisons (pesticides) through the registration and labeling requirements of the Act. The labeling provisions of the Act specify in considerable detail what must appear on the label or labeling. In applying for registration of a pesticide, the manufacturer must submit with the application data and other evidence that will establish beyond any reasonable doubt that when the product is used in accordance with directions or commonly recognized practice, it will not be injurious to man, other vertebrate animals, vegetation, the person applying such poisons, or endanger the public health. Thus, you will find that certain of the newer pesticides have not been approved and registered for use on fruit and vegetable crops and cannot legally bear labels recommending such usage. I frankly do not know what might



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Dr. Donald E. H. Frear, Editor of PESTICIDE HANDBOOK 1952, is one of the leading authorities on the chemistry of pesticides. He is the author of "Chemistry of Insecticides and Fungicides," the first book dealing with this subject published in the United States. In addition, he has written several other books, including "Chemistry of Insecticides, Fungicides, and Herbicides." Dr. Frear is Professor of Agricultural and Biological Chemistry at The Pennsylvania State College.

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happen if you purchased such materials properly labeled for some other legitimate use and applied them to fruits or vegetables when such usage was not recommended or covered in the labeling. I believe, however, I would be prepared to take the consequences before adopting such a questionable procedure.

In conclusion, let me summarize briefly. There are no official tolerances in existence at the present time. We fully expect that, as a result of the recent Food and Drug hearings, official tolerances will be established, but we do not know when. It is possible we may have legislation which will directly or in effect prohibit the use of some pesticidal chemicals either temporarily or permanently. For the time being, the food producer has certain responsibilities which must be met. He must, of course, produce marketable crops at a profit to remain in business, but at the same time he is obligated to market a product that is safe for use by the consumer.

Practically all laws are made to correct existing evils and the tendencies of some individuals to infringe upon the rights of others. If every pesticide user would, to the best of his ability, observe all the necessary restrictions and precautions required to produce a crop free of dangerous pesticidal residues, there would be little or no need for tolerances or other regulations governing pesticide usage. The majority of our food producers are conscientious in this regard and give us very little or no trouble, but as you are well aware, we do have careless or indifferent individuals who will, through ignorance, or for selfish reasons, gamble on anything, including the health and well being of others. Laws are enacted and regulations are promulgated to regulate and curb the activities of these individuals. It may seem unjust that the majority should be inconvenienced, penalized, or punished for the actions of a few, but apparently we have no alternative.

My advice would be: Follow recommended and approved practices to the best of your ability. Insofar as possible, control insect pests and diseases early in the season, and do not use highly toxic or questionable materials late in the season. The majority have observed and will continue to observe such precautions, but remember, if you become careless and lose control over some pest or pests just before harvest, that is your mistake and you must pay the penalty. The mere fact that insects or plant diseases are threatening your crop in the immediate pre-harvest period does not give you license to apply hazardous chemicals that will endanger the health of others.

ALABAMA

(*Continued from Page 61*)

Despite the heavy snowstorm, the annual banquet was attended by 85, including many wives. Preceding the dinner was a cocktail party sponsored by Homer Kindig, Greenwood Products; Jim Atkinson, General

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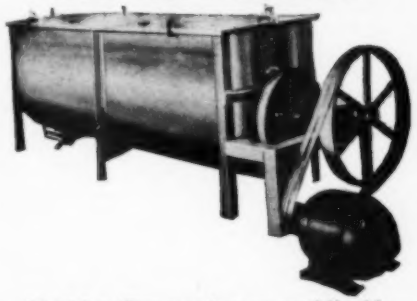

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Chemical, Birmingham, Ala.; C. M. Crutchfield, California Spray Chemical, Decatur, Ala.; Jim Wirwille, Pennsalt, Montgomery, Ala.; R. P. Coggans, American Cyanamid, Montgomery, Ala., and George R. Williamson, Agricultural Sulphur & Chemical Co. of Montgomery and Dothan, Ala.

ACS MEETING

(*Continued from Page 59*)

be protected from worm attack through much of the growing season, some residues are unavoidable.

A similar study on the necessity for residues was made by Dr. James G. Horsfall, director, Connecticut Agricultural Experiment Station, New Haven, Conn., who presented a paper, "Fungicides on Vegetable Crops." He pointed out that without a regular spraying schedule on potatoes, more than half of that crop would be wiped out by blight.

Without fungicides, there would be very little celery and melons and cucumbers would be "scrawny and speckled with rot." Peanuts and carrots would likewise be in short supply, and although wheat and corn are not usually sprayed or dusted, most of the seed is treated chemically to control fungus pests.

The paper assured that farmers are not making expensive chemical treatments unless they obtain extra yield to repay for the trouble.

"Insecticides on Vegetable Crops" were discussed in a paper by T. C. Allen, Univ. of Wisconsin, Madison. He said that use of the newer insecticides is highly desirable to produce vegetable crops economically. Because of their effectiveness, fewer treatments are needed, reducing costs for labor, material and application and also reducing mechanical injury to the crop.

In protecting vegetables from insects, insecticides may be applied either to palatable or non-palatable portions of the plant. A minimum toxic residue on the plant results from the application of the minimum amount of insecticide required to effect economic insect control. Only with the aid of the newer organic insecticides, can vegetable crops of the highest possible quality be produced on an economic basis.

Livestock, too, must be treated for various insect pests. In a paper by Dr. E. F. Knipling, assistant chief, B.E.P.Q., Washington, D. C., "Insecticides on Livestock," it was pointed out that flies, ticks, mites, lice, screw-worms and cattle grubs affect the health and production of all kinds of livestock. Flies alone may decrease milk yields as much as 10% to 20% and reduce weight gains of beef cattle as much as 0.5 pounds per day. It is necessary to employ insecticides for maximum production of meat, milk and animal fibers, the paper said.

There is a wide variation in the properties of available materials in regard to residues stored in fatty tissues or excreted in milk. The persistence of the residues of different insecticidal chemicals in animal product also varies.

Every effort is being made to employ materials which do not cause

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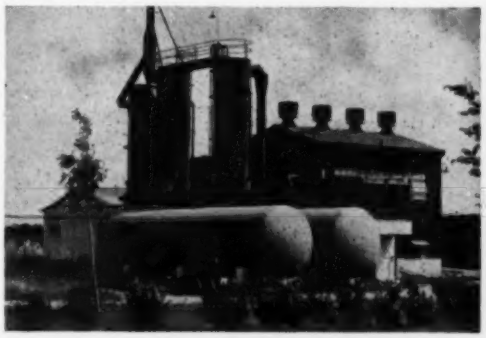

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residues in animal products. However, those leaving no residue are not economical for controlling some of the most destructive pests.

"Problem Can Be Solved"

EDGAR C. Britton, Dow Chemical Co., Midland, Mich., was to preside at a morning session on April 3, wherein the physical factors in deposition and persistence of insecticides were discussed. Appearing on this portion of the program were Walter Ebling, Univ. of Calif., Los Angeles; W. M. Hoskins, Univ. of Calif., Berkeley; A. S. Crafts, Univ. of Calif., Davis; and L. W. Hazleton, Hazleton Laboratories, Falls Church, Va.

Dr. Haller was to preside again at the afternoon session of April 3, at which time the practical factors in persistence were discussed.

"Deposits and Residues" were covered in a paper by Dr. George C. Decker, C. J. Weinman and J. M. Bann, Illinois Natural History Survey, Urbana, Ill. The paper stated that the residues of a series of insecticidal chemicals will tend to disappear in the order of the volatility of the compounds themselves. For example, under a given set of conditions, the residues of parathion, lindane, aldrin, chlordane, dieldrin, toxaphene and DDT will be lost and will eventually disappear in the order named.

Dr. J. L. St. John, Food Protection Committee of the National Research Council, Washington, D.C., spoke on harvest residues, discussing the status of the spray residue problem with reference to residues at harvest, trends and the bearing of different factors on the final residue level.

Residue removal was the subject of a paper by L. B. Norton, Cornell University, Ithaca, N. Y. He said that excessive residues of some inorganic pesticides have been removed by washing with acid or alkaline solutions. Some of the more volatile, unstable or soluble organic compounds may be dissipated largely before harvest or eliminated during processing operations. In view of this, many of the recent organic materials offer considerable difficulty because of low water solubility, high stability and solubility in plant fats and waxes.

That the cooperative effort of the food chemist, food technologist and entomologist will be required to determine the significance of residues or other degradation products in foods, was brought out by Charles H. Mahoney, National Canners Association, Washington, D.C. "The problem does not appear to be so complicated that it cannot be solved by cooperative effort," he declared.

"Residues in Animal Tissues and Products" was the title of a paper presented by Paul A. Dahm, Kansas State College, Manhattan, to complete the program of that section. He pointed out the difficulties associated with obtaining reliable information in this type of work and summarized the distribution, effect, probable metabolism and persistence of these residues. The use of radioisotope-labeled parathion to supplement information already known, was described.

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Miscellaneous

Distributorships Available in some areas for Tykor Insecticidal Sano-White, the leading insecticidal white wall coating. Widely accepted by commercial sprayers, farmers and others as best available. Referred to in '52 Spring Farm Quarterly article. Write Tykor Products Division, The Borden Company, 350 Madison Avenue, New York 16.

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Fert. Price Exemptions

The Office of Price Stabilization has recently issued an order (GOR to Chapt. III of Title 32A) exempting from price control a long series of chemicals and drugs. Included in the list of materials which are now exempt from price control are the following fertilizer materials: acid fish scrap, almond shells, beet sugar residue, cocoa shell meal, cocoa tankage, compost, cotton hull ashes, distillery waste, furfural waste, grape pomace, guano, hoof and horn meal, humus, manure (animal and fowl excrement only), mowrah meal, muck, mustard meal, peanut hulls, peat, peat moss, precipitated bone, rapeseed meal, ravison meal, spent bone black, tung nut hulls, tung oil pomace, wood ashes and wood waste.

•

New C. A. Directory

The 37th directory of county agents is now available for distribution. The 228 page book entitled 1952 *County Agents Directory* covers such topics as reference information on spraying and dusting, table of measures, etc., articles on new cattle and beef grades, the national emergency and flexible extension programs. It lists among others, members of the USDA, Agricultural Research Administration, U. S. Department of the Interior, state agricultural experiment stations, and state and national granges. The price is $5.00 and it is available from County Agents Directory, 139 North Clark Street, Chicago 2, Illinois.

•

New Fruit Bulletin

A new booklet prepared by the horticulturists at the New York State Agricultural Experiment Station is now available. Listing the trees in order of time of ripening, the varieties best adapted for New York States are included. The different sorts are also marked for commercial importance or for trial as especially promising.

•

Control Cryolite Exports

Purchases of cryolite for export from the United States must now be specifically authorized by the National Production Authority. This requirement was set up in NPA's Order M-99, effective March 1. On the same date the Office of International Trade began to require validated export licenses for exports of cryolite to all foreign destinations except Canada.

Issue Sulfur Report Forms

Forms to be filled in and filed by all consumers and suppliers of sulfur and sulfuric acid, were recently distributed by the Chemical Division of the National Production Authority, U. S. Dept. of Commerce. Every person who uses more than 20 short tons of sulfur in any calendar month is required to file a monthly report with NPA on Forms NPAF-157 and NPAF-158. Such reports are due on the fifteenth of each month.

Suppliers of sulfur must file monthly reports of sales, imports, production, shipments and stocks with the Bureau of Mines on forms 6-1230-M and 6-1238-M. These are due on the tenth of each month.

Consumers of sulfuric acid are now required to file report NPAF-161, consumer's report of end-use; NPAF-160, consumer's report of inventory and receipts; and NPAF-159, consumer's report of uses in calendar years 1950 and 1951. (The latter form, 159, was to have been filed in February.) The report on inventory and receipts (160) must be filed by the 20th of each month.

Suppliers of sulfuric acid must file NPAF-162, a monthly report of production, inventory, orders and proposed deliveries. These are to be filed by the 15th of each month.

In cases where additional supplies of sulfuric acid are needed to meet production requirements, requests for such assistance must be filed on form NPAF-138-b.

•

CSMA to Boston in June

The Chemical Specialties Manufacturers Association will hold its mid-year meeting at the Copley-Plaza hotel, Boston, Mass., June 8-10, it has been announced.

•

U. S. I. Wall Chart

U. S. Industrial Chemicals, New York recently announced that it has available a 14 x 22 two-color chart showing 28 insects that are harmful to man. The chart gives a little history of the various insects and has a drawing of each. It is free upon request to U. S. Industrial Chemicals, 60 East 42nd Street, New York.

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TALE ENDS

PROBABLY unique in the annals of fertilizer manufacturing is the arrangement recently made by the Forkin Phosphate Co., Green Bay, Wis., to satisfy complaints made by townspeople about the odors they said were originating at the plant. Up to February 9, the plant had taken care of its odors very nicely through proper equipment, but on that date the equipment broke down and the complaints started.

The plant then agreed to shut down operations whenever the wind blew from the north, thus making sure not to offend its neighbors to the south. This arrangement was to remain in force until March 17, at which time new fume-reducing equipment was to be installed.

Target....

A WELL-AIMED bullet hits the target just like good industrial advertising in the right magazines, — those magazines which specialize in serving the markets which you want to sell. For example, the magazine which specializes in serving the fields of insecticides, herbicides, fertilizers, fungicides, and other chemical specialties and supplies, is

AGRICULTURAL CHEMICALS

175 FIFTH AVE. NEW YORK 10, N. Y.

American Plant Food Council was to be host to the officers and regional directors of the National Flying Farmers at a dinner, March 23rd, in the course of their annual meeting at Denver, Colo.

•

The National Fertilizer Association's *Fertilizer News* for March 12, carries a story about how workers at Northern Chemical Industries' sulfuric acid plant in Maine came to work on snow shoes to keep the plant operating around the clock. The state suffered its most severe winter on record and "Yankee ingenuity" had to take over to solve the problem. J. E. Totman, president of the organization and chairman of the NFA Board of Directors, states that the relay procedure which involved not only snowshoes and skis, but a "ham" radio system, lasted three days. With the radio system, they rounded up workers who trudged an average of five miles to the plant to relieve those on duty and keep production under way. Mr. Totman commented that this is probably the first time a sulfuric acid plant was ever operated by a "snowshoe gang."

•

"Rodent Control Teams" are operating in the midwest with the same competitive spirit found in athletic events, it is reported. The teams are composed of about 25 young members of the Future Farmers of America organization. These groups keep score on the numbers of rats and mice they kill, and losers treat the winners to a banquet or show. In one case in Iowa, a team called the "Rodenteers" accumulated a total of 15,705 points in swamping their rivals, the "Rodent Detectives," who had managed to garner only 5,705 points. Victims of the project were not only rats and mice, but included sparrows, pigeons, starlings, foxes, crows and groundhogs.

Dealers in communities where such activities are under way might sell a considerable extra amount of rodenticides if the FFA were contacted.

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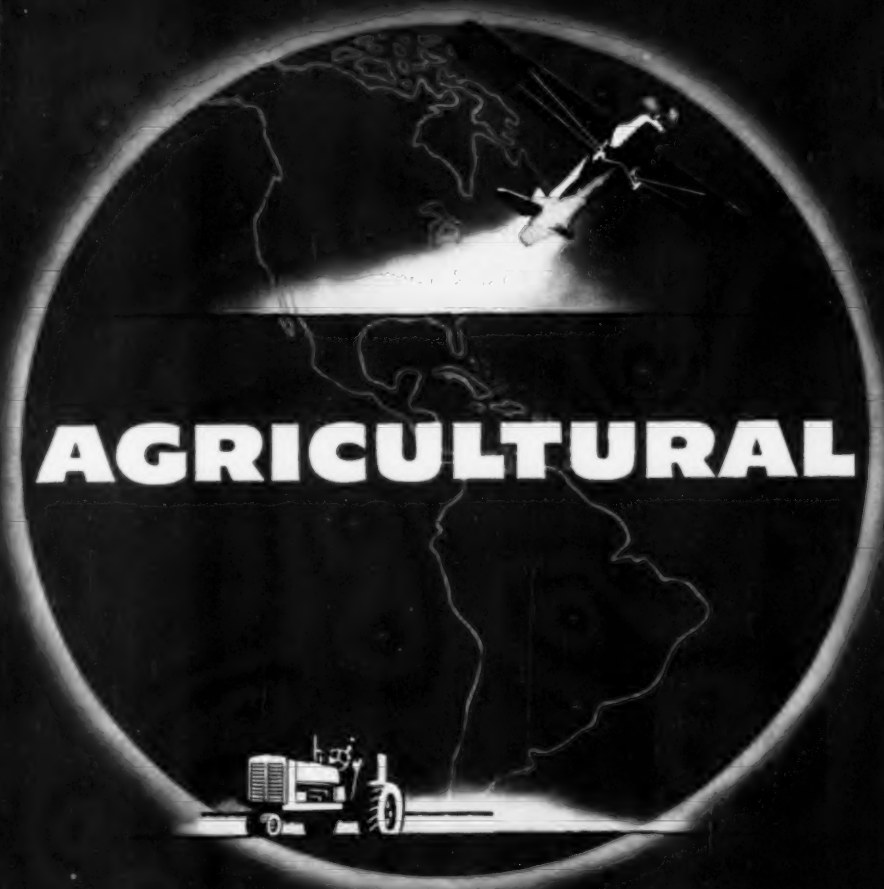
International MINERALS & CHEMICALS phosphate division

INTERNATIONAL MINERALS & CHEMICAL CORPORATION

General Offices: 20 North Wacker Drive, Chicago 6

TOXAPHENE



AGRICULTURAL

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HERCULES POWDER COMPANY